Frontline Scientific Research Projects Advanced in JAPAN

— Newly Selected Large-scale Research Projects under FY2008 Grants-in-Aid for Scientific Research —

December, 2008

Japan Society for the Promotion of Science (JSPS)
(http://www.jsps.go.jp/english/index.html)

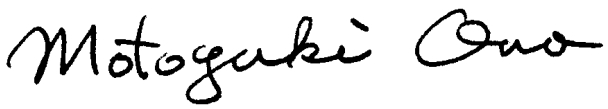
Foreword

The program Grants-in-Aid for Scientific Research, or *Kakenhi*, supports a full spectrum of basic to applied research in all scientific fields including the humanities, social sciences and natural sciences. These grants are competitive research funds disbursed to spur milestone advances in research carried out based researchers' own free ideas. Grant selection is made via a system of peer reviews aimed at funding highly creative, cutting-edge research projects. As such, they constitute the core research funding used to build Japan's research infrastructure.

A variety of Grant-in-Aid categories have been established to correspond to a wide range of research objectives and contents. Grant selections are made based on open calls for applications. This booklet introduces grant projects newly selected in FY 2008 in the categories Specially Promoted Research, Scientific Research (S) and Grant-in-Aid for Young Scientists (S), which support research expected to yield particularly outstanding results. The research projects introduced herein have received high international appraisal.

It is hoped that this booklet will help to enhance understanding of research activities in universities and other Japanese research institutions.

Motoyuki Ono



President
Japan Society for the Promotion of Science

Contents

(page)

Grant-in-Aid for Specially Promoted Research of KAKENHI、FY2008 (Newly Adopted Projects)

3. Abstracts of the Newly Adopted Projects

【Integrated Science and Innovative Science】

(Comprehensive fields)

Grant-in-Aid for Young Scientists (S) of KAKENHI、FY2008 (Newly Adopted Projects)

Grant-in-Aid for Specially Promoted Research

☐ Distribution by Research Area of the Newly Adopted Projects

Purpose and Character of Grant-in-Aid for Specially Promoted Research (excerpt from the "Application Procedures for Grants-in-Aid for Scientific Research"):

1) **Intended for**:
Research project carried out by one researcher or by a relatively small group of researchers that is likely to yield highly acclaimed research achievements through intensive funding. The goal of the funding is the increased promotion of research which is highly regarded in the international arena.

2) **Total budget provided (total budget throughout the research period)**:
There is no limit to the total budget although, as a guide, a total budget of around 500 million yen per research project may be awarded

3) **Research period**: Three to five years

4) **Number of research projects scheduled to be selected**: Around 10 (subject to strict selection)

【 New Projects】

	Number of Applications			Total Grant Disbursements (FY2008)	Per-project Grants (FY2008)	
	Received	Adopted	Ratio		Average	Largest
			(%)	(in thousands of yen)	(in thousands of yen)	(in thousands of yen)
Humanities and Social Sciences	5	2	40.0	93,700	46,850	67,800
Science and Engineering	80	12	15.0	1,327,700	110,642	261,400
Biological Sciences	29	5	17.2	486,400	97,280	122,800
Total	114	19	16.7	1,907,800	100,411	261,400

【 New and Ongoing Projects】

	Number of Applications	Total Grant Disbursements (FY2008)	Per-project Grants (FY2008)	
			Average	Largest
		(in thousands of yen)	(in thousands of yen)	(in thousands of yen)
Humanities and Social Sciences	8	431,500	53,938	122,300
Science and Engineering	52	4,125,200	79,331	261,400
Biological Sciences	26	2,495,200	95,969	306,100
Total	86	7,051,900	81,999	306,100

※ Figure reflects only direct funding

List of the Newly Adopted Projects for Grant-in-Aid for Specially Promoted Research of KAKENHI、FY2008

（1）Humanities and Social Sciences (2 Projects)

(in Thousands of Yen)

Principal Investigator		Title	Term of Project	Annual Budget / Budget throughout for the Entire Research Period
Tetsuro Matsuzawa	Kyoto University, Primate Research Institute, Professor	Primate foundation of cognitive development	2008-2012	67,800 / 330,200
Akira Isobe	Tohoku University, Center for Northeast Asian Studies, Professor	A Study of the Culture of Court Theatre during the Qing Dynasty	2008-2012	25,900 / 128,200

（2）Science and Engineering (12 Projects)

○Mathematics/Physics (6 Projects)

(in Thousands of Yen)

Principal Investigator		Title	Term of Project	Annual Budget / Budget throughout for the Entire Research Period
Hisayoshi Yurimoto	Hokkaido University, Department of Natural History Sciences, Professor	Anatomy of protosolar system	2008-2012	105,500 / 467,100
Fumihiko Suekane	Tohoku University, Graduate School of Science, Associate Professor	New Development of Neutrino Physics by Reactor Neutrinos	2008-2012	132,200 / 377,700
Kotaro Kohno	The University of Tokyo, School of Science, Associate Professor	A Study of the Evolution of Large Scale Structures Based on the Ultra Wide Band Millimeter And Submillimeter Observations	2008-2012	129,700 / 510,500
Tetsuo Irifune	Ehime University, Geodynamics Research Center, Professor	Behavior of Fe-bearing materials under very high pressure and mineralogy of the lowermost mantle and the inner core	2008-2012	78,900 / 434,100
Ryugo Hayano	The University of Tokyo, Department of Physics, Professor	Contribution to fundamental physical constants using exotic-atom spectroscopy	2008-2012	59,700 / 231,300
Yoshio Kitaoka	Osaka University, Graduate School of Engineering Science, Professor	New Quantum Phases of Matter in Multidimensional Environments	2008-2012	95,200 / 450,600

○Chemistry (3 Projects)

(in Thousands of Yen)

Principal Investigator		Title	Term of Project	Annual Budget / Budget throughout for the Entire Research Period
Toshiaki Enoki	Tokyo Institute of Technology, Graduate School of Science and Engineering, Professor	Physical chemistry of nanographene edges: edge states and their electronic and magnetic functions	2008-2012	127,700 / 298,200
Koji Tanaka	Institute for Molecular Science, Department of Life and Coordination-Complex Molecular Science, Professor	Reversible Conversion between Electrical Energy and Chemical one Mediated with Coordination Complexes	2008-2011	36,800 / 126,800
Tohru Fukuyama	The University of Tokyo, Graduate School of Pharmaceutical Sciences, Professor	Synthetic Studies on Biologically Functional Molecules	2008-2012	82,600 / 310,500

○Engineering (3 Projects)

(in Thousands of Yen)

Principal Investigator		Title	Term of Project	Annual Budget / Budget throughout for the Entire Research Period
Masaaki Sato	Tohoku University, Graduate School of Biomedical Engineering, Professor	Study of Mechanisms of Cellular Mechanosensing	2008–2012	128,300 / 414,800
Takeshi Yamakawa	Kyushu Institute of Technology, Graduate School of Life Science and Systems Engineering, Professor	Identification of Epileptogenic Focus by Employing Softcomputing and Establishment of Minimally Invasive and Definitive Surgery	2008–2011	261,400 / 433,200
Tetsuya Osaka	Waseda University, Faculty of Science and Engineering, Professor	Establishment of Electrochemical Device Engineering	2008–2012	89,700 / 438,800

(3)Biological Sciences (5 Projects)

(in Thousands of Yen)

Principal Investigator		Title	Term of Project	Annual Budget / Budget throughout for the Entire Research Period
Masatoshi Takeichi	RIKEN Laboratory for Cell Adhesion and Tissue Patterning, Group Director	Regulation of cell behavior by the interplays between cadherin adhesion molecules and cytoskeleton	2008–2012	62,500 / 304,200
Akihiko Nakano	The University of Tokyo, Graduate School of Science, Professor	Molecular Mechanisms of Protein Sorting in Membrane Traffic and Roles in Higher Plants	2008–2012	104,600 / 458,800
Shimon Sakaguchi	Kyoto University, Institute for Frontier Medical Sciences, Professor	Molecular basis of the function and generation of Foxp3-expressing regulatory T cells	2008–2012	117,900 / 460,200
Tatsuya Hirano	RIKEN Chromosome Dynamics Laboratory, Chief Scientist	Molecular mechanisms of chromosome assembly mediated by condensins	2008–2012	78,600 / 356,000
Shizuo Akira	Osaka University, Immunology Frontier Research Center, Professor	Comprehensive analysis of innate immunity	2008–2012	122,800 / 671,600

【Humanities and Social Sciences】

Title of Project	Primate foundation of cognitive development
Principal Investigator Name	Tetsuro　Matsuzawa, Kyoto University, Primate Research Institute, Professor
Abstract of Research Project **Number of Researchers：4** **Term of Project：2008–2012**	What is the unique feature of human mind and its development? The present study aims to clarify the evolutionary basis of human mind by examining the mind of chimpanzees, the evolutionary neighbors. The focus is the period of puberty, about 8-12 years old. The main subjects are the chimpanzees in Kyoto University and the ones in their natural habitat in Africa. From the viewpoint of comparative cognitive science, we study the information processing, concept, memory, attention, emotion, etc. This will clarify the nature of chimpanzee mind and its constraints. Therefore, it may illuminate the primate foundation of cognitive development.

Title of Project	A Study of the Culture of Court Theatre during the Qing Dynasty
Principal Investigator Name	Akira Isobe, Tohoku University, Center for Northeast Asian Studies, Professor
Abstract of Research Project **Number of Researchers：7** **Term of Project：2008–2012**	Theatre in China has not just been a form of cultural entertainment, but has also had close bearings on the psychological makeup of the Chinese, the formation of their attitudes, and the spread of Sinocentric thought. Its origins lie in the court theatre of the Qing dynasty, and theatre was considered to go beyond the confines of performing art and form part of national culture. In this study we will take up the culture of court theatre, which formed part of the Qing's national policy and, focusing on its social reception and development, will clarify the role played by Qing court theatre within the system of rule of the Great Qing Empire (*gurun*), and we will deduce its cultural characteristics and further advance the substantive understanding of China.

【Science and Engineering（Mathematics/Physics）】

Title of Project	Anatomy of protosolar system
Principal Investigator Name	Hisayoshi Yurimoto, Hokkaido University, Department of Natural History Sciences, Professor
Abstract of Research Project **Number of Researchers : 3** **Term of Project: 2008-2012**	Recently we developed a state-of-the-art instrument of isotope microscopy and applied to meteorite analyses. We discovered that circumstellar materials formed before solar system formation are embedded in meteorites. This discovery demonstrates that evolution from the circumstellar materials to solar system materials can be directly traced by isotope microscopy. In this project, we continue to develop the anatomy of meteorite by isotope microscopy more precisely. The new generation isotope microscopy will clarify material evolution during and before our solar system formation. Based on the results, we propose new scenario of origin of solar system including our specificity and universality. This is a challenge to universal theory of origin of planetary system in galaxy based on material evidence.

Title of Project	New Development of Neutrino Physics by Reactor Neutrinos
Principal Investigator Name	Fumihiko Suekane, Tohoku University, Graduate School of Science, Associate Professor
Abstract of Research Project **Number of Researchers : 5** **Term of Project: 2008-2012**	The neutrino is an elementary particle which is not well understood yet. Knowing the properties of neutrino is important to deepen our understanding of the nature. There are 3 types of neutrinos. The type changes spontaneously during traveling due to neutrino oscillation. There are 3 kinds of neutrino oscillations. Two of them have already been measured. However, the 3rd oscillation has not been detected yet. The purpose of this experiment is to discover the last neutrino oscillation using reactor neutrinos. The experiment will be performed at Chooz nuclear power station in France. By comparing the data from 2 neutrino detectors which locate near and far from the reactors, the amplitude of the 3rd neutrino mixing will be precisely measured. This experiment completes the determination of amplitudes of all three neutrino oscillations and the neutrino physics will go into a new step.

Title of Project	A Study of the Evolution of Large Scale Structures Based on the Ultra Wide Band Millimeter And Submillimeter Observations
Principal Investigator Name	Kotaro Kohno, The University of Tokyo, School of Science, Associate Professor
Abstract of Research Project **Number of Researchers : 8** **Term of Project: 2008-2012**	The goal of the project is to unveil the evolutions of the true star formation activities and large scale structures in the early universe. First, we will conduct unprecedented millimeter/submillimeter-wave surveys, which are very efficient to detect dusty starbursts in the early universe. A large numbers of dust enshrouded massive young starburst galaxies will be uncovered. Because they are often invisible in optical and infrared observations, it could be referred as “dark galaxies”. The distances (or epochs) of them will then be determined based on our own methods. We will build a multi-color camera and ultra-wide-band spectrometers using superconducting devices, and they will be mounted on the new submillimeter telescope ASTE in Chile and other telescopes. From these results, we will unveil the true history of the cosmic star formation. The evolution of dark matter distributions will also be addressed through the analysis of clustering properties of galaxies.

【Science and Engineering（Mathematics/Physics）】

Title of Project	Behavior of Fe-bearing materials under very high pressure and mineralogy of the lowermost mantle and the inner core
Principal Investigator Name	Tetsuo Irifune, Ehime University, Geodynamics Research Center, Professor
Abstract of Research Project Number of Researchers : 5 Term of Project: 2008–2012	Application of nano-polycrystalline diamond and sintered-polycrystalline diamond to ultra high-pressure generation will be pursued using both diamond anvil cell and multianvil apparatus to realize static pressures equivalent to the central part of the Earth. Using these techniques, combined with synchrotron X-ray and ultrasonic measurements, we will particularly focus on the crystal structure of metallic iron, nature of electron spin transitions in Fe-bearing minerals, and chemical compositions of the lower mantle and the core. First-principles calculation will also be adopted to investigate these subjects at the P, T conditions where the experiments are difficult to cover.

Title of Project	Contribution to fundamental physical constants using exotic-atom spectroscopy
Principal Investigator Name	Ryugo Hayano, The University of Tokyo, Department of Physics, Professor
Abstract of Research Project Number of Researchers : 1 Term of Project: 2008–2012	Exotic atoms denote systems in which a heavy negatively-charged particle (e.g., antiproton) is bound by the Coulomb force to the nucleus. Precision spectroscopy of exotic atoms yields fundamental constants, such as the proton-to-electron mass ratio, which cannot be obtained in the studies of ordinary atoms. Since exotic atoms do not exist in nature, accelerators are necessary for their studies. This project emphasizes precision studies of two kinds of exotic helium atoms, 1) antiprotonic helium (at CERN's antiproton decelerator facility) and 2) kaonic helium (at the hadron-hall of J-PARC accelerator complex in Tokai, Japan). The laser spectroscopy of antiprotonic helium atoms, which has already contributed to the CODATA 2006 values, will improve the precision of the relative atomic mass of the electron, while the X-ray spectroscopy of kaonic helium atoms will experimentally pin down the kaon-nucleus strong-interaction strength, the subject of hot theoretical debate for the past 10 years.

Title of Project	New Quantum Phases of Matter in Multidimensional Environments
Principal Investigator Name	Yoshio Kitaoka, Osaka University, Graduate School of Engineering Science, Professor
Abstract of Research Project Number of Researchers : 7 Term of Project: 2008–2012	In order to create the basic science and engineering of twenty-first century, it is necessary to investigate the new quantum phases of matter in multidimensional environment, especially in the research field of strongly correlated matter. Through this specially promoted research project, we address intriguing properties in the new quantum phases of matter and their physical backgrounds. Main targets are fundamental research aiming at the creation of novel quantum materials exhibiting cooperative and competitive effects of the typical quantum functions of materials, such as superconductivity, magnetism, and ferroelectricity, and the establishment of heretofore unexplored fundamental principles of materials science through the elucidation of new quantum functions of these materials; these will be achieved by combining evolutional experimental techniques and theoretical analysis in an interdisciplinary approach .

【Science and Engineering（Chemistry）】

Title of Project	Physical chemistry of nanographene edges: edge states and their electronic and magnetic functions
Principal Investigator Name	Toshiaki Enoki, Tokyo Institute of Technology, Graduate School of Science and Engineering, Professor
Abstract of Research Project Number of Researchers : 4 Term of Project: 2008–2012	Nanographene, which is intermediate in size between graphene and polycyclic aromatic hydrocarbon molecules, has electronic structure that crucially depends on the geometry of its edge structure. Around zigzag edges are created unconventional edge states having localized spins. The edge states not only play important roles in electron reservoirs and active sites for chemical reactions, but also provide building blocks in designing molecular magnets. The present project aims at creating a new frontier of science on nanographene edges on the basis of atomic-resolution studies of the electronic structure of nanogaraphene edges. It also contributes to clarifying the mechanism of electron transfer and chemical reaction in nanographene, building a new class of carbon-based molecular magnets, and developing electronic/spintronic molecular devices.

Title of Project	Reversible Conversion between Electrical Energy and Chemical one Mediated with Coordination Complexes
Principal Investigator Name	Koji Tanaka, Institute for Molecular Science, Department of Life and Coordination-Complex Molecular Science, Professor
Abstract of Research Project Number of Researchers : 1 Term of Project: 2008–2011	Since James Watt's invention of steam engines about 250 years ago, our society has been heavily relying on thermal energy released by combustion of tremendous amounts of fossil fuel. Conversion of electrical energy to chemical one would provide the most reasonable methodology to fix non-steady natural energies and to store extra electricity generated by power plants at night. The aim of this study is to develop molecular catalysts that are able to catalyze conversion between carbon dioxide and methanol through six-electron redox reactions of those molecules.

Title of Project	Synthetic Studies on Biologically Functional Molecules
Principal Investigator Name	Tohru Fukuyama, The University of Tokyo, Graduate School of Pharmaceutical Sciences, Professor
Abstract of Research Project Number of Researchers : 3 Term of Project: 2008–2012	Overcoming the serious diseases such as cancers and Alzheimer's disease is one of the most important issues in the aging society. Accordingly, intensive efforts for developing new and effective medicines to cure these diseases are actively pursued. Natural products have recently drawn renewed interests and attentions as the seeds of novel medicines. However, availability of such natural products from nature tends to be severely limited. In order to develop novel medicines from natural products, sufficient amounts of compounds need to be provided for derivatization and biological testing. One of the goals of our research program is to establish practical synthetic routes for the natural products of medicinal importance. In addition, a variety of derivatives of the natural products will be synthesized for biological testing.

【Science and Engineering（Engineering）】

Title of Project	Study of Mechanisms of Cellular Mechanosensing
Principal Investigator Name	Masaaki SATO, Tohoku University, Graduate School of Biomedical Engineering, Professor
Abstract of Research Project **Number of Researchers : 6** **Term of Project: 2008–2012**	The cells constituting tissues/organs can sense mechanical forces (termed as "mechanosensing"). Vascular endothelial cells, bone cells, and articular chondrocytes, which are the main focus of this study, are typical examples of cells with mechanosensors. These cells exhibit morphological and functional changes in response to external forces; however, the underlying sensing mechanisms are still unknown. The aim of this study is to elucidate the mechanisms by using a combination of cutting-edge bio-imaging and computer simulation techniques as well as novel experimental methods to specifically apply mechanical forces to local regions of the cells.

Title of Project	Identification of Epileptogenic Focus by Employing Softcomputing and Establishment of Minimally Invasive and Definitive Surgery
Principal Investigator Name	Takeshi Yamakawa, Kyushu Institute of Technology, Graduate School of Life Science and Systems Engineering, Professor
Abstract of Research Project **Number of Researchers : 5** **Term of Project: 2008–2011**	Epilepsy is a chronic brain disorder characterized by recurrent seizures. The seizure is shot down by the surgical removal of the region which is so called "epileptogenic focus". However, the accuracy to detect the focus is not good (order of cm). Thus the extirpation of origin with significant margin causes the removal of healthy brain and leads to the severe aftereffects such as restricted vision, motor dysfunction, disorder of memory, and so on. To cope with this problem, we should develop the technology of (1) detecting the epileptogenic focus, and (2) necrotizing the epileptogenic focus excluding healthy brain by (a) colliquative necrosis with flash freezing or (b) cauterizing by focused laser beam.

Title of Project	Establishment of Electrochemical Device Engineering
Principal Investigator Name	Tetsuya Osaka, Waseda University, Faculty of Science and Engineering, Professor
Abstract of Research Project **Number of Researchers : 4** **Term of Project: 2008–2012**	Electrochemistry deals with systems of interface between electrode and electrolyte, and it covers industrial products and processes including batteries, energy devices, chemical sensors, surface treatments, electronic devices, and chemical analysis. The objective of this research is to establish 'electrochemical device engineering' based on the design of electrode/electrolyte interface with a single-layer or multi-layers of atoms and/or molecules. The work will be focused on the development of energy devices and chemical sensors, and three- or two-dimensional designs of interface will be investigated to establish the basic concept for device fabrication processing. In addition, nano-particle systems of functional materials will be studied, which can be considered as zero dimensional material systems. The smart design concept based on 'electrochemical device engineering' will be established as this research makes a progress.

【Biological Sciences】

Title of Project	Regulation of cell behavior by the interplays between cadherin adhesion molecules and cytoskeleton
Principal Investigator Name	Masatoshi Takeichi, RIKEN Laboratory for Cell Adhesion and Tissue Patterning, Group Director
Abstract of Research Project **Number of Researchers : 1** **Term of Project: 2008-2012**	Dissociated animal cells can actively move. Also during development, cells undergo active movement as well as deformation of cell layers, indicating that cell motility is essential for body construction. On the other hand, cells are attached to each other to maintain the body. Therefore, cell adhesion needs to be regulated for cells to move. Conversely, the cell adhesion itself is known to regulate cell movement. In this study, we explore the mechanisms of how cell adhesion molecules co-operate with cytoskeletal proteins to regulate cell behavior. The outcomes of this study are expected to contribute to not only our deeper understandings of developmental mechanisms but also designing remedies for cancer metastasis.

Title of Project	Molecular Mechanisms of Protein Sorting in Membrane Traffic and Roles in Higher Plants
Principal Investigator Name	Akihiko Nakano,The University of Tokyo, Graduate School of Science,Professor
Abstract of Research Project **Number of Researchers : 8** **Term of Project: 2008-2012**	Membrane traffic is a process of protein transport between organelles mediated by small membrane vesicles. Complex sets of machinery sort and convey proteins through multiple rounds of vesicle budding and fusion. Many questions remain to be answered, which will be approached in this project by the combination of genetics, biochemistry (complete cell-free reconstitution) and state-of-the-art imaging. Live cell imaging using our custom-made high-speed confocal microscope will be particularly powerful to solve problems that have been otherwise unable to attack. Elucidation of molecular mechanisms of membrane traffic will then be extended to understanding of their roles in higher plants from the viewpoints of development, physiology, and responses to environments.

Title of Project	Molecular basis of the function and generation of Foxp3-expressing regulatory T cells
Principal Investigator Name	Shimon Sakaguchi, Kyoto University, Institute for Frontier Medical Sciences, Professor
Abstract of Research Project **Number of Researchers : 8** **Term of Project: 2008-2012**	Naturally arising regulatory T cells (Tregs), which specifically express the transcription factor Foxp3, are engaged in the maintenance of immunological self-tolerance (i.e., immunological unresponsiveness to self-constituents) and immune homeostasis. Dysfunction of Tregs can be a cause of autoimmune disease, allergy, and immunopathology. In this project, we plan to decipher at the molecular level how Foxp3 controls the generation and function of Tregs, in particular how Foxp3 confers suppressive activity to Tregs. Our ultimate goal is to devise new ways of controlling suppressive function of Tregs to treat and prevent immunological diseases.

【Biological Sciences】

Title of Project	Molecular mechanisms of chromosome assembly mediated by condensins
Principal Investigator Name	Tatsuya Hirano, RIKEN Chromosome Dynamics Laboratory , Chief Scientist
Abstract of Research Project **Number of Researchers :8** **Term of Project: 2008–2012**	The long-term goal of this study is to understand the molecular mechanisms of chromosome assembly and segregation with a major focus on the role of condensins in these processes. We will examine the spatial and temporal regulation of two condensin complexes in vertebrate cells, and explore a potential functional link between chromosome duplication and condensation. We will also study the molecular architecture and activities of condensins to understand how this class of sophisticated molecular machines might work at a mechanistic level. The proposed study will directly be relevant to our understanding of human health because chromosome aberrations are often associated with tumor development or birth defects.

Title of Project	Comprehensive analysis of innate immunity
Principal Investigator Name	Shizuo Akira, Osaka University, Immunology Frontier Research Center, Professor
Abstract of Research Project **Number of Researchers : 4** **Term of Project: 2008–2012**	Innate immunity initially recognizes invading pathogens, eradicates them, and further activates acquired immunity. Innate immunity research field is rapidly advancing by studies including identification of roles of Toll-like receptors (TLRs). However, the entire picture of the molecular mechanisms has not been understood. The goal of this study is to clarify the molecular mechanism of the innate immune system from the initial pathogen recognition to the activation of acquired immunity. For the comprehensive understanding of innate immune system, we will integrate various approaches such as gene recombination techniques, molecular imaging and systems biology.

List of the Continuing Projects for Grant-in-Aid for Specially Promoted Research of KAKENHI

Humanities and Social Sciences (5 Projects)

Principal Investigator		Title	Term of Project	Total (Thousand yen)
Takashi Inoguchi	Chuo University, Faculty of Law, Professor	An Empirical Study of Life Styles, Norms and Values through the AsiaBarometer	2005-2008	234,500
Yutaka Tsujinaka	University of Tsukuba, Graduate School of Humanities and Social Sciences, Professor	A Comprehensive Empirical Study on the Three-Level Civil Society Structure and Governance in Japan, South Korea, the United States, Germany, and China in Comparative Perspective	2005-2009	191,300
Noriyuki Takayama	Hitotsubashi University, Institute of Economic Research, Professor	Economic Analysis of Intergenerational Issues	2006-2010	500,400
Hiroshi Hirano	Gakushuin University, Faculty of Law, Professor	Nation-wide Longitudinal Survey Study on Voting Behavior in an Age of Political Changes	2007-2011	110,400
Toshiyuki Wakatsuki	Kinki University, Faculty of Agriculture, Professor	Materialization of West African rice green revolution through Sawah based eco-technology and the creation of African adaptive Satoyama watershed systems	2007-2011	226,000

Science and Engineering (40 Projects)

Principal Investigator		Title	Term of Project	Total (Thousand yen)
Sanae-I. Itoh	Kyushu University, Research Institute for Applied Mechanics, Professor, Fellow of Institute of Physics	Research on Structural Formation and Selection Rules in Turbulent Plasma	2004-2008	378,200
Katsuo Tokushuku	High Energy Accelerator Research Organization (KEK), Institute of Particle and Nuclear Studies, Professor	Precision tests of the Standard Model based on high-energy collisions between the proton and the longitudinally-polarized electron	2004-2008	215,100
Atsuto Suzuki	Tohoku University, Professor Emeritus	High Precision and High Sensitivity Measurements of Electron Anti-Neutrinos from Reactors and inside the Earth, and Electron Neutrinos from the Sun	2004-2008	638,100
Hiroshi Tsunemi	Osaka university, Graduate school of science, Professor	Observational study of the cosmic hot plasma and the development of the high performance X-ray CCD	2004-2008	285,600
Toshio Narita	Hokkaido University, Professor Emeritus	Formation of diffusion barrier bond coat to realize high reliable and Long life thermal barrier coating	2004-2008	452,700
Minoru Isobe	Nagoya University, GraduateSchool of Bioagricultural Sciences, Professor	The Innovative Synthesis of Bioactive Moleculeson the basis of the Molecular Mechanism of Natural Products' Activity	2004-2008	175,000
Masataka Nakazawa	Tohoku University, Research Institute of Electrical Communication, Professor	Establishment of novel ultrahigh-speed distortion-free optical transmission technology using time-domain optical Fourier transformation	2004-2008	325,400
Mitsuo Kira	Tohoku University, Professor Emeritus	Highly Controlled New Materials of Heavy Group-14 Elements.Creation and Development of Their Unique Functions	2005-2008	182,400
Takeshi Fukuda	Kyoto University, Institute for Chemical Research, Professor	Science and Technology of Concentrated Polymer Brushes	2005-2008	419,300
Masatoshi Arai	Japan Atomic Energy Research Institute, Center for Neutron Science, R&D Group for Neutron Instrument, Group Leader, Principal Scientist	Development of the 4D Spaces Access Neutron Spectrometer (4SEASONS) and Elucidation of the Mechanism of Oxide High-Tc Superconductivity	2005-2009	615,700

Principal Investigator		Title	Term of Project	Total (Thousand yen)
Haruhiko Suzuki	Kanazawa University, Graduate School of Natural Science and Technology, Professor	Study of Quantum Critical Phenomena at Micro Kelvin Temperatures	2005–2009	185,100
Masayuki Hasegawa	Tohoku University, Professor Emeritus	Clarification of Embrittlement and Degradation Mechanisms of Nuclear Steel Materials by Advanced Nano-Materials Science and its Applications for Control and Prediction of the Materials Integrity	2005–2009	338,400
Keizo Ishii	Tohoku University, Graduate School of Engineering, Professor	Development of Semiconductor PET Scanner with the Ultra High Resolution of less than 1mm FWHM :Next Generation PET	2005–2009	423,500
Hideyuki Sakai	The University of Tokyo, Graduate School of Science, Professor	Spin-isospin responses in nuclei in time-like region by means of exothermic charge-exchange reactions	2005–2009	444,400
Akira Namiki	Kyushu Institute of Technology, Faculty of Engineering, Professor	Basic Processes In Hydrogen Atom-Surface Reactions: Spin Effect, Reaction Dynamics, and Origin of Interstellar Hydrogen Molecules	2005–2009	132,700
Shin' ichi Oishi	Waseda University, Faculty of Science and Engineering, Professor	Establishment of Verified Numerical Computation	2005–2009	329,700
Tadahiro Ohmi	Tohoku University, New Industry Creation Hatchery Center, Professor	Balanced Full CMOS LSI for Ultra High Performance and Ultra Low Power Consumption	2006–2008	434,500
Takahiro Iwata	Yamagata University, Faculty of Science, Professor	Study of quark-gluon structure of hadrons with a large polarized target	2006–2009	136,400
Tsutomu Katsuki	Kyushu University, Graduate School, Faculty of Sciences, Professor	Development of environment-conscious synthetic reactions: construction of reaction coordinate-response catalyst	2006–2009	255,100
Terutaka Goto	Niigata University, Institute of Science and Technology, Professor	Strongly correlated quantum phase associated with charge fluctuation	2006–2010	218,800
Yoshihisa Yamamoto	National Institute of Informatics, Principles of Informatics Research Division, Professor	Qubus Quantum Computer	2006–2010	452,700
Jian Ping Gong	Hokkaido University, Faculty of Science, Professor	Material Innovation for the Age of Life Science – Creation of Soft and Wet Materials	2006–2010	351,700
Makoto Komiyama	The University of Tokyo, Research Center for Advanced Science and Technology, Professor	Gene Manipulation of Huge DNA by Super Artificial Restriction Enzyme	2006–2010	331,700
Takashi Fukui	Hokkaido University, Graduate School of Information Science and Technology, Professor	Semiconductor Nanowire Electronics by Selective-Area Metal-Organic Vapor Phase Epitaxy	2006–2010	411,100
Toru Sugitate	Hiroshima University, Graduate School of Science, Professor	Formation of Quark Matter and Photon Physics	2006–2010	311,300
Yasuo Cho	Tohoku University, Research Institute of Electrical Communication, Professor	Next Generation Super High Density Ferroelectric Data Storage Using Scanning Nonlinear Dielectric Microscopy Technique	2006–2010	435,100
Junichi Tsujii	The University of Tokyo, Graduate School of Information Science and Technology, Professor	Generic Methods for Knowledge-based Semantic and Contextual Processing in Natural Language Understanding	2006–2010	384,100
Kazuto Yamauchi	Osaka University, Graduate School of Engineering, Professor	Sub-10nm hard X-ray focusing and application to nanoscopy/spectroscopy	2006–2010	202,200
Masahiro Hirama	Tohoku University, Graduate School of Science, Professor	Chemical Syntheses of Natural and Designed Molecules: Innovative Research on Their New Functions, Antibodies, and Receptors	2007–2010	327,000

Principal Investigator		Title	Term of Project	Total (Thousand yen)
Yukihiro Takahashi	Tohoku University, Graduate School of Science, Professor	Investigations on TLEs and TGFs using micro-satellite and ground observation network	2007-2010	351,900
Katsumi Tanimura	Osaka University, The Institute of Scientific and Industrial Research, Professor	Dynamical studies of photoinduced structural phase transitions	2007-2011	522,800
Kosuke Morita	RIKEN ,Superheavy Element Laboratory, Nishina Center for Accelerator Based Science, Associate Chief Scientist	Searching for new elements and chemistry of superheavy elements	2007-2011	479,200
Hajime Shimizu	Tohoku University, Graduate School of Science, Professor	Quark Nuclear Physics with a Photon Beam	2007-2011	334,300
Yasunori Yamazaki	The University of Tokyo, Graduate School of Arts and Sciences, Professor	Developments of antimatter science with antihydrogen atoms and antihydrogen ions	2007-2011	294,800
Kaoru Yamanouchi	The University of Tokyo, School of Science, Professor	Ultrafast hydrogen migration	2007-2011	450,000
Morinobu Endo	Shinshu University, Faculty of Engineering, Professor	Selective Growth of CVD-based Carbon Nanotubes through the Nanostructured Control and Their Novel Multi-functions	2007-2011	442,900
Seiji Takeda	Osaka University, Graduate School of Science, Professor	Atomistic and electronic structural analysis of the catalyst mechanism of metal nanoparticles in gases	2007-2011	470,100
Kohei Tamao	RIKEN, Advanced Science Institute, Director	Construction and Functions of Novel Elemento-Organic Compounds by Introduction of Innovative and Versatile Bulky Gorups	2007-2011	436,200
Yôiti Suzuki	Tohoku University, Research Institute of Electrical Communication, Professor	Spatiotemporal integration of multimodal sensory information	2007-2011	344,500
Shigehisa Arai	Tokyo Institute of Technology, Quantum Nano Electronics Research Center, Professor	InP-based membrane-type optical and electric devices for broad band intra-chip/inter-chip interconnection in Si-LSI circuits	2007-2011	424,400

Biological Sciences (21 Projects)

Principal Investigator		Title	Term of Project	Total (Thousand yen)
Toshio Suda	Keio University, School of Medicine, Professor	Regulation of Hematopoietic Stem Cell Division in a Niche	2004-2008	352,000
Haruo Kasai	The University of Tokyo, Graduate school of Medicine, Professor	Dynamics of synapse and exocytosis studied with two-photon excitation microscope	2004-2008	463,000
Yoshinori Fujiyoshi	Kyoto University, Graduate School of Science, Professor	Structural study of signal transduction through membrane proteins, channels and receptors	2004-2008	421,200
Masayuki Yamamoto	The University of Tokyo, Graduate School of Science, Professor	Regulatory mechanisms of meiosis	2004-2008	272,900
Kazuhiko Kinosita	Waseda University, Faculty of Science and Engineering, Professor	Elucidating mechanisms of biological molecular machines by single-molecule physiology	2004-2008	449,000
Shigekazu Nagata	Kyoto University, Graduate School of Medicine, Professor	Molecular mechanism of cell death and its physiological roles	2005-2009	347,000
Tasuku Honjo	Kyoto University, Graduate School of Medicine, Immunolgy and Genomic Medicine, Professor	AID-dependent genetic alteration mechanism to generate antigen-specific antibodies	2005-2009	588,000

Principal Investigator		Title	Term of Project	Total (Thousand yen)
Shigetada Nakanishi	Osaka Bioscience Institute, Director	Studies on molecular mechanisms that control development and function of the neural network	2005–2009	498,000
Yoshinori Watanabe	The University of Tokyo, Institute of Molecular and Cellular Biosciences, Professor	Mechanisms that lead to the difference in equational and reductional chromosome segregation	2005–2009	307,300
Keiji Tanaka	Tokyo Metropolitan Organization for Medical Research, The Tokyo Metropolitan Institute of Medical Science, Vice director	Analyses of Molecular Assembly and Diversity of Proteasomes	2005–2009	494,500
Yoshihiro Kawaoka	The University of Tokyo, Institute of Medical Science, Professor	Mechanism of emergence of new influenza viruses and their control	2006–2010	445,000
Daisuke Yamamoto	Tohoku University, Graduate School of Life Sciences, Professor	Studies on the mechanism of neural and behavioral sex determination by the Drosophila fruitless gene	2006–2010	342,400
Nobutaka Hirokawa	The University of Tokyo, Graduate School of Medicine, Professor	The Mechanism of Intracellular Transport and Kinesin Motors, KIFs : Structure, Function, Dynamics and Regulation	2006–2010	1,494,600
Shuh Narumiya	Kyoto University, Graduate School of Medicine, Professor	Spatiotemporal control of cell functions by Rho GTPases; mechanisms and physiological roles	2006–2010	493,200
Hitoshi Okamura	Kyoto University, Graduate School of Pharmaceutical Sciences, Professor	Molecular Clocks to Biological Rhythms	2006–2010	448,600
Takao Shimizu	The University of Tokyo, Graduate school of Medicine, Professor	Phospholipid metabolism and lipid mediators	2007–2011	595,900
Yasushi Miyashita	The University of Tokyo, Graduate School of Medicine, Professor	Dynamical mechanisms underlying cognitive memory in primates: Functional analysis of its global network and local circuits	2007–2011	527,900
Hitoshi Sakano	The University of Tokyo, Graduate School of Science, Professor	Neural Circuit Formation in the Mouse Olfactory System	2007–2011	542,600
Chikashi Toyoshima	The University of Tokyo, Institute of Molecular and Cellular Biosciences, Professor	Structural biology of ion transporters	2007–2011	420,800
Shinya Yamanaka	Kyoto University, Institute for Frontier Medical Sciences, Professor	Molecular mechanisms underlying nuclear reprogramming of somatic cells	2007–2011	487,000
Yoshinori Ohsumi	National Institute for Basic Biology, Dept of Cell Biology, Professor	Molecular, Mechanisms and Diversity of Autophagy	2007–2011	431,900

Grant-in-Aid for Scientific Research (S)

☐ Distribution by Research Area of the Newly Adopted Projects

Purpose and Character of Grant-in-Aid for Scientific Research (S) (excerpt from the "Application Procedures for Grants-in-Aid for Scientific Research"):

1) **Intended for:**
Research project performed by one researcher or by a relatively small group of researchers, with the purpose of achieving a major development in creative and pioneering research, based on past research achievements

2) **Total budget provided:**
From 50 million yen to around 200 million yen

3) **Research period:**
Five years as a general rule

【 New Projects】

	Number of Applications			Total Grant Disbursements (FY2008)	Per-project Grants (FY2008)	
	Received	Adopted	Ratio		Average	Largest
			(%)	(in thousands of yen)	(in thousands of yen)	(in thousands of yen)
Integrated Science and Innovative Science	126	21	16.7	724,700	34,510	78,500
Humanities and Social Sciences	34	6	17.6	168,300	28,050	52,700
Science and Engineering	244	42	17.2	1,815,600	43,229	96,800
Biological Sciences	147	25	17.0	974,900	38,996	78,000
Total	551	※94	17.1	3,683,500	39,186	96,800

※ 86 projects implemented as eight were also selected under another grant program.

【 New and Ongoing Projects】

	Number of Applications	Total Grant Disbursements (FY2008)	Per-project Grants (FY2008)	
			Average	Largest
		(in thousands of yen)	(in thousands of yen)	(in thousands of yen)
Integrated Science and Innovative Science	88	1,694,600	19,257	78,500
Humanities and Social Sciences	25	469,800	18,792	52,700
Science and Engineering	157	3,399,900	21,655	96,800
Biological Sciences	102	2,141,200	20,992	78,000
Total	372	7,705,500	20,714	96,800

※ Figure reflects only direct funding

List of the Newly Adopted Projects for Grant-in-Aid for Scientific Research (S) of KAKENHI、FY2008

(1)Integrated Science and Innovative Science （21 Projects）

○ Comprehensive fields（11 Projects）

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Yoshihiko Nakamura	The University of Tokyo/Graduate School of Information Science and Technology/Professor	ESTABLISHING HUMAN-MACHINE COMMUNICATION THROUGH KINESIOLOGY AND LINGUISTICS INTEGRATION	FY2008-2012	38,200 156,200
Hiroshi Ishiguro	Osaka University/Graduate School of Engineering/Professor	Studies on humanlike presence by using tele-operated androids	FY2008-2012	35,700 161,700
Kazuo Fujita	Kyoto University/Graduate School of Letters /Professor	Awareness, self-reflection, and mind-reading:Genesis and functions of cognitive meta-processes.	FY2008-2012	39,300 143,300
Toshio Inui	Kyoto University/Graduate School of Informatics/Professor	Brain mechanisms of dynamic image generation based on body schema	FY2008-2012	35,400 162,000
Kuniyoshi Sakai	The University of Tokyo/Graduate School of Arts and Sciences/Associate Professor	The Elucidation of Sign Language Acquisition Mechanism Based on the Linguistic Function of the Brain	FY2008-2012	23,500 113,100
Masahiko Takada	Tokyo Metropolitan Organization for Medical Research/Tokyo Metropolitan Institute for Neuroscience/Staff Scientist & Director	Analyses of architecture and functions of cerebral networks by target neuron-selective activity suppression and tract-tracing approaches	FY2008-2012	31,700 127,700
Katsuhiko Mikoshiba	RIKEN/Brain Science Institute/Group Director	Study of IP3 receptor/Ca2+ signaling in neural plasticity and brain development and differentiation	FY2008-2012	31,700 159,700
Harunori Ohmori	Kyoto University/Graduate School of Medicine/Professor	Neuronal identification by fluorescence spectrogram, and the application to auditory neural circuits in vivo	FY2008-2012	29,100 127,100
Yoichiro Iwakura	The University of Tokyo/The Institute of Medical Science/Professor	Establishment of a IL-1-related gene manipulated mouse library to understand diseases from a systems biological view point	FY2008-2011	9,300 78,100
Yasuhiko Tabata	Kyoto University/Institute for Frontier Medical Sciences/Professor	Development of Technology to Manipulate the Biological Functions of Stem cells for Cell therapy of Next Generation	FY2008-2012	29,400 129,400
Nobuyuki Kamba	National Institutes for Cultural Heritage Tokyo National Museum/Curatorial Research Department/Supervisor of Conservation	Study on a Primary Conservation System for Sustainable Access and Preservation of the Cultural Heritage in Museums	FY2008-2012	32,200 76,200

○ New multidisciplinary fields（10 Projects）

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Keiichiro Ohshima	Hokkaido University/Institute of Low Temperature Science/Professor	Global mapping and monitoring of sea ice production	FY2008-2012	57,900 162,400
Ichiro Yasuda	The University of Tokyo/Ocean Research Institute/Professor	Direct observations of tidal mixing and studies on ocean/climate variability synchronized with 18.6-year period nodal tidal cycle	FY2008-2012	36,200 163,700
Shinsuke Tanabe	Ehime University/Center for Marine Environmental Studies/Professor	Environmental Contamination and Ecological Risk of Novel POPs in the Asian Developing Region	FY2008-2012	31,600 125,100
Yasuhiro Sugawara	Osaka University/Graduate School of Engineering/Professor	Investigation of Mechanical Manipulation of Atoms and Molecules on Insulator Surfaces with Extreme Field Atomic Force Microscopy	FY2008-2012	14,000 70,900

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Kohzo Ito	The University of Tokyo/Graduate School of Frontier Sciences/Professor	Dynamic Control of Slide-Ring Materials	FY2008-2012	25,200 155,900
Toshio Ando	Kanazawa University/Graduate School of Natural Science and Technology/Professor	Innovative High-speed AFM for Elucidating Vital Phenomena	FY2008-2012	32,700 149,800
Hideaki Takayanagi	Tokyo University of Science/Research Institute for Science and Technology/Professor	Development of a nano-SQUID and its application to quantum information	FY2008-2012	78,500 160,100
Haruhiko Siomi	Keio University/School of Medicine/Professor	Fathoming the evolution of gene regulation through an 'arms race' between transposons and Argonautes	FY2008-2012	44,100 164,100
Hiroyuki Aburatani	The University of Tokyo/Research Center for Advanced Science and Technology/Professor	Integrated analysis of transcriptional regulation in cancer	FY2008-2012	39,000 161,400
Takao Hamakubo	The University of Tokyo/Research Center for Advanced Science and Technology/Professor	Dynamic Proteomics of Transcriptional Machinery and Nuclear Architecture	FY2008-2012	30,000 151,600

(2)Humanities and Social Sciences (6 Projects)

○ Humanities (2 Projects)

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Yuzuru Hayashi	The University of Tokyo/Historiographical Institute/Professor	A Study of Constructing of the Historical Ontology with Digitizing of Historical Materials	FY2008-2012	52,700 151,900
Akihiro Watanabe	National Institutes for Cultural Heritage Nara National Research Institute for Cultural Properties/ Department of Imperial Palace Sites Investigations/Head of History Section	The improvement of the Support system to decode excavated historical documents and the development of the comprehensive research center database	FY2008-2012	28,700 104,000

○ Social sciences (4 Projects)

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Akira Okada	Hitotsubashi University/Department of Economics/Professor	Frontiers of Game Theory: Theory and Applications	FY2008-2012	30,300 139,600
Hiroyuki Chuma	Hitotsubashi University/Institute of Innovation Research/Professor	Joint Research on Innovation Processes among Industry, Universities and Government	FY2008-2012	24,200 109,200
Akira Kohsaka	Osaka University/School of International Public Policy/Professor	Spill-Over and Cycle Effects of Regional Integration: Growth and Cycles of Asia and Enlarged EU	FY2008-2011	18,700 68,200
Sawako Shirahase	The University of Tokyo/Graduate School of Humanities and Sociology/Associate Professor	A Comprehensive Study Examining the Forms of Social Stratification in an Aging Society and Constructing Public Norms	FY2008-2012	13,700 129,400

(3) Science and Engineering (37 Projects)

○ Mathematical and physical sciences (12 Projects)

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Mitsuhiro Nakao	Kyushu University/Faculty of Mathematics/Professor	Development of computer assisted analysis for complicated nonlinear phenomena	FY2008-2011	19,400 65,300
Hideo Kozono	Tohoku University/Graduate School of Science/Professor	Theory of global well-posedness on the nonlinear partial differential equations	FY2008-2012	24,400 136,800
Masayuki Umemura	University of Tsukuba/Graduate School of Pure and Applied Sciences/Professor	Probing the Dark Age: From First Generation Objects to Primordial Galaxies	FY2008-2012	10,900 73,100
Ken Takayama	High Energy Accelerator Research Organization/Accelerator Laboratory/Professor	Digital Accelerator based on the Induction Acceleration Method	FY2008-2010	67,900 166,700
Yasuo Miake	University of Tsukuba/Graduate School of Pure and Applied Sciences/Professor	Study of Jets in Quark Gluon Plasma with Parton Identification	FY2008-2012	8,700 65,400
Makoto Gonokami	The University of Tokyo/School of Engineering/Professor	Many body quantum phenomena in electron-hole ensembles	FY2008-2012	29,600 115,300
Hiroshi Daimon	Nara Institute of Science and Technology/Graduate School of Materials Science/Professor	Small-area two-dimensional photoelectron spectroscopy	FY2008-2012	29,000 132,200
Yuji Matsuda	Kyoto University/Graduate School of Science/Professor	Exotic Superconducting State of Heavy Fermion Compounds	FY2008-2012	54,000 165,200
Noriaki Sato	Nagoya University/School of Science/Professor	Investigation of novel quantum states in actinide-based compounds with unstable valence	FY2008-2012	67,100 149,900
Tomoo Katsura	Okayama University/Institute for Study of the Earth's Interior/Professor	Rheology of the high-pressure mantle minerals using giant single crystals and technology of high-pressure generation in large volumes	FY2008-2012	95,700 175,100
Tanio Ito	Chiba University/Graduate School of Science/Professor	Research on active tectonics in central Japan based on integrated seismic experiments with long shot- and receiver-offsets	FY2008-2010	71,800 147,600
Yukio Isozaki	The University of Tokyo/Graduate School of Arts and Sciences/Professor	Study on Mass Extinction: The P-T boundary and V-C boundary events	FY2008-2012	31,900 102,900

○ Chemistry (6 Projects)

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Masahiko Takahashi	Tohoku University/Institute of Multidisciplinary Research for Advanced Materials/Professor	Visualization of electron transfer in matter with a time-resolved reaction microscope for electron Compton scattering	FY2008-2012	30,000 118,400
Kenso Soai	Tokyo University of Science/Faculty of Sciences/Professor	The Origins of Chirality and Amplification in Asymmetric Autocatalysis	FY2008-2012	51,200 159,200
Masahiro Yamashita	Tohoku University/Graduate School of Science/Professor	Switching Phenomena in Super-Paramagnets Controlled by External Stimuli	FY2008-2012	70,900 164,400

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Nobuaki Kambe	Osaka University/Graduate School of Engineering/Professor	Development and Control of Highly Efficient Catalytic Systems for Cross- and Multicomponent-Coupling Reactions	FY2008-2012	42,700 122,700
Kazuo Akagi	Kyoto University/Graduate School of Engineering/Professor	Synthesis of Conjugated Polymers with Higher-Ordered Helical Structures in Helicity-Controllable Liquid Crystal Field and Their Functional Properties	FY2008-2012	60,200 151,400
Eiji Yashima	Nagoya University/Graduate School of Engineering/Professor	Development of Materials with Novel Properties and Functions Based on Controlled Double-Stranded Helical Structure	FY2008-2012	18,800 88,900

○ Engineering Ⅰ（11 Projects）

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Kazuo Nakajima	Tohoku University/Institute for Materials Research/Professor	Investigation of crystal growth mechanisms of Si crystals floating on Si melt and development of crystal growth technique to realize high-quality Si multicrystals	FY2008-2010	44,900 114,700
Susumu Noda	Kyoto University/Graduate School of Engineering/Professor	Dynamic control of photonic crystal for new functionality	FY2008-2012	34,300 160,100
Yasuo Kokubun	Yokohama National University/Graduate School of Engineering/Professor	Semiconductor microring processor using wavelength channel control	FY2008-2012	50,100 138,700
Hiroyuki Hama	Tohoku University/Graduate School of Science/Professor	Study and Development of Extremely Short Pulse Coherent Terahertz Light Source Employing an Electron Isochronous Ring	FY2008-2012	39,600 159,300
Yoji Shibutani	Osaka University/Graduate School of Engineering/Professor	Plastic Physics of Defect Mechanics	FY2008-2012	28,200 89,700
Akira Miyamoto	Tohoku University/New Industry Creation Hatchery Center/Professor	Development of Multi-level Tribological Simulator based on Ultra-accelerated Quantum Chemical Molecular Dynamics	FY2008-2012	57,600 153,600
Ichiro Hagiwara	Tokyo Institute of Technology/Graduate School of Science and Engineering/Professor	Research on Creating Function of New Lightweight Core Structure and Its Forming Method by Fusion of Computational Mechanics and Origami Engineering	FY2008-2012	38,900 151,700
Kouhei Ohnishi	Keio University/Science and Tehcnology/Professor	Research and Development on Platform of Science and Engineering for Human Support Based on Real-World Haptics	FY2008-2012	23,900 114,300
Yoshiaki Nakano	The University of Tokyo/Research Center for Advanced Science and Tehcnology/Professor	Digital Photonics -Paradigm Shift of Optoelectronics	FY2008-2012	32,800 122,900
Kazuo Nakazato	Nagoya University/Graduate School of Engineering/Professor	BioCMOS technology and its application to portable biosensor instruments	FY2008-2012	26,500 75,700
Makoto Ishida	Toyohashi University of Technolog/Department of Electrical and Electronic Engineering/Professor	An implantable chip with integrated microprobe/tube arrays for electrical neural recording, stimulation, and drug delivery applications	FY2008-2012	29,100 161,900

○ Engineering Ⅱ （8 Projects）

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Yozo Fujino	The University of Tokyo/Graduate School of Engineering/Professor	Prediction of Ultimate Performance of Civil Infrastructure using Dense Vibration Monitoring	FY2008-2012	26,600 75,100
Juko Ito	Kumamoto University/Graduate School of Science and Technology/Professor	Interdisciplinary Research on Architecture and Urban Environment of Ancient Greek Cities of Messene and Phigalia	FY2008-2012	16,600 92,800
Akihisa Inoue	Tohoku University/President	Fabrication and Industrialization of Large-Sized Bulk Metallic Glasses of Centimeter-Size Class	FY2008-2012	68,700 157,600
Jin Onuki	Ibaraki University/College of Engineering/Professor	Nano-scale Structural Control of Cu interconnects Using An Extreme High-purity Electro-plating Process and Its Application to Next Generation Nano-scale ULSI	FY2008-2012	60,600 161,300
Tadafumi Ajiri	Tohoku University/Advanced Institute for Materials Research/Professor	Synthesis of organic-inorganic hybrid nanoparticles by surpercritical fluid and thermodynamics and unit operation of hybrid nanoparticles	FY2008-2012	34,900 152,500
Atsushi Fukuoka	Hokkaido University/Catalysis Research Center/Professor	Synthesis of Fuels and Chemicals by Catalytic Conversion of Inedible Biomass	FY2008-2012	46,100 143,700
Atsushi Fukuyama	Kyoto University/Graduate School of Engineering/Professor	Development of Kinetic Integrated Simulation Code for Toroidal Plasmas	FY2008-2012	26,800 75,800
Hiroshi Yamada	National Institute for Fusion Science/Department of Large Helical Device Project/Professor	Production and Control of Super-Dense Plasmas towards an Innovative Ignition Regime for a Fusion Reactor	FY2008-2012	45,300 122,200

（4）Biological Sciences （22 Projects）

○ Biology （7 Projects）

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Masamitsu Wada	Kyushu University/Faculty of Sciences/Professor special appointment	Functional Analysis of Newly-found Actin Structure Involved in Chloroplast Photorelocation Movement	FY2008-2012	47,800 159,800
Yoshinori Shichida	Kyoto University/Graduate School of Science/Professor	Functional Diversity of Visual Pigments and Photoreceptor cells	FY2008-2012	53,400 159,800
Osamu Nureki	The University of Tokyo/Institute of Medical Science/Professor	Structural basis for molecular mechanisms of substrate recognition and transport regulation by membrane transporters	FY2008-2012	40,700 159,900
Yuichiro Maeda	Nagoya University/Graduate School of Science/Professor	Structure and dynamics of actin filament complex:mechanism of calcium regulation of muscle contraction	FY2008-2012	11,000 158,200
Yoshifumi Nishimura	Yokohama City University/International Graduate School of Arts and Sciences/Professor	Dynamics of intrinsically disordered proteins and their functional roles	FY2008-2012	42,000 138,000
Hiroyuki Araki	National Institute of Genetics/Department of Cell Genetics/Professor	Molecular mechanism and regulation of assembly and remodeling of proteins	FY2008-2012	14,700 153,700
Kozo Kaibuchi	Nagoya University/Graduate School of Medicine/Professor	Molecular Networks for the Regulation of Cell Polarization in Migrating Cells and Neurons	FY2008-2012	30,000 150,000

○ Agricultural sciences (6 Projects)

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Kazumitsu Ueda	Kyoto University/Institute for Integrated Cell-Material Sciences/Professor	Physiological substances and functions of ABC proteins involved in lipid transport	FY2008-2012	22,900 123,900
Teruo Miyazawa	Tohoku University/Graduate School of Agricultural Science/Professor	Studies on lipid peroxidation in human disease: its modulation from the view point of food chemistry	FY2008-2012	29,000 155,900
Yuzuru Suzuki	The University of Tokyo/Graduate School of Agricultural and Life Sciences/Professor	Improved breeding of fugu following whole genome sequencing	FY2008-2012	46,600 146,600
Hiroshi Nonami	Ehime University/Faculty of Agriculture/Professor	Cell Turgor Measurement – Probe Electrospray Ionization (PESI) Mass Spectrometry for Molecular Profiling Techniques	FY2008-2012	21,900 124,300
Hiroshi Ozaki	The University of Tokyo/Graduate School of Agricultural and Life Sciences/Professor	Studies on the phased immune-barrier systems in gut-liver axis focusing on immune responses of mesenchymal cells	FY2008-2012	24,500 117,300
Takafumi Uchida	Tohoku University/Geaduate school of Agricultural Science/Professor	Finding of Regulatory Proteins of Microtubule Polymerization and Discovery of Natural Compounds against Dementia	FY2008-2012	16,800 80,800

○ Medicine, dentistry, and pharmacy Ⅰ (6 Projects)

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Masakatsu Shibasaki	The University of Tokyo/Geaduate school of Pharmaceutical Sciences/Professor	Innovative Asymmetric Synthesis of Pharmaceuticals Through Strategic Development of Multifunctional and Multimetallic Catalysts	FY2008-2012	53,500 160,700
Tsutomu Masujima	Hiroshima University/Geaduate School of Biomedical Sciences/Professor	Single-cell on-time molecular analysis by hyper-sensitive video-mass scope	FY2008-2011	49,500 160,700
Hidenori Ichijo	The University of Tokyo/Graduate School of Pharmaceutical Sciences/Professor	Establishment of the basis for drug development by the analysis of molecular mechanisms of stress signaling	FY2008-2012	32,400 160,400
Shinichi Nishikawa	RIKEN/Stem Cell Research Group/Group Director	Analysis of Methylome of Cancer by high throughput sequencer	FY2008-2012	28,700 148,700
Chihiro Sasakawa	The University of Tokyo/The Institute of Medical Science/Professor	Study of Shigella infectious strategy for the intestinal barrier	FY2008-2012	56,800 152,800
Hitoshi Kikutani	Osaka Universtiy/Research Institute for Microbial Diseases/Professor	Roles of guidance factors in immune regulation	FY2008-2012	47,300 159,300

○ Medicine, dentistry, and pharmacy Ⅱ (3 Projects)

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Takashi Kadowaki	The University of Tokyo/University Hospital/Professor	An integrative elucidation of the energy metabolism-regulating system and its disruption	FY2008-2012	78,000
				174,800
Masahiro Hiraoka	Kyoto University/Graduate School of Medicine/Professor	Development of an innovative radiotherapy technologies for the improvement of treatment outcomes of intractable cancers	FY2008-2012	50,700
				159,100
Toshiyuki Yoneda	Osaka University/Graduate School of Dentistry/Professor	Integrative Study of transcriptional network systems during enchondral ossification	FY2008-2010	52,100
				164,100

ESTABLISHING HUMAN-MACHINE COMMUNICATION THROUGH KINESIOLOGY AND LINGUISTICS INTEGRATION

Yoshihiko Nakamura
(The University of Tokyo, Graduate School of Information Science and Technology, Professor)

【Outline of survey】

The advance of Robot Technology (RT) is about to change what the human-machine interface used to be. Humanoid robots with morphological similarity to the human beings, that is due to the advance in hardware technology, will change the relationship between the humans and the machines from a static, stiff, dry and ostensible one to a sensible, flexible, intimate, and intuitive one. The technology such as dynamic simulation and motion analysis will provide the means for computers to estimate human somatosensory sensations. The horizon shows the possibility of the human-machine interface with which computers or robots communicate using gestures and natural language. By establish human-machine communication through integration of kinesiologic information and linguistic information, this study aims to:

(A) solve the fundamental problem of machine intelligence,
(B) establish the technological foundation of robot intelligence
(C) investigate the principle of higher information processing of the humans, and
(D) provide an approach to study "theory of mind" in the brain science

【Expected results】

Integrating kinesiology and natural language brings out the new machines that communicate with the humans using gestures and natural languages. Establishing technology with which a machine acquires the knowledge using its body movements and linguistic association, a robot becomes communicable with an ordinary person and starts assistance in the human daily life.

【References by the principal investigator】

・ T. Inamura, Y. Nakamura and I. Toshima: “Embodied Symbol Emergence based on Mimesis Theory,” Intern. J. of Robotics Research, vol.23, no.4/5, pp.363-378, 2004.
・ Y. Nakamura, K. Yamane, Y. Fujita, and I. Suzuki: “Somatosensory Computation for Man-Machine Interface from Motion Capture Data and Musculoskeletal Human Model,” IEEE Trans. on Robotics, vol.21, no.1, pp.58-66, 2005.
・ Y. Nakamura:“*“Creating the Robot Brains,”* Iwanami Lectures, The World of Physics, Iwanami, 2003 (in Japanese).

【Term of project】 FY2008− 2012	【Budget allocation】 156,200,000 yen (direct cost)

【Homepage address】 http://www.ynl.t.u-tokyo.ac.jp/

Studies on humanlike presence by using tele-operated androids

Hiroshi Ishiguro
(Osaka University, Graduate School of Engineering, Professor)

【Outline of survey】

This research project will study humanlike presence with cognitive methods by using a “geminoid,” that is, a tele-operated android identical in appearance to the principal investigator.

People expect to be able to converse naturally with an android that has humanlike appearance and behavior. However, autonomous conversation capability is not yet practical, due to limitations in technologies for speech recognition and artificial intelligence. The geminoid has solved this problem by using tele-operation techniques. In the geminoid system, an operator can communicate with people through the geminoid’s body by sending voice and movements through the internet, creating a feeling of presence as if he/she were actually there. This study goes beyond the mere humanlikeness of the android to investigate the phenomenon of humanlike presence.

This research project will focus on improvement of the geminoid system, studying humanlike presence by cognitive and neuro-scientific approaches, and development of robots that have the minimum design for conveying humanlike presence.

【Expected results】

The research project will introduce new research methodologies for using androids in cognitive science. That is, we expect to be able to gain understanding about humans by observing their interactions with other humans and with robots.

On the other hand, the development of the geminoid system provides us with a new communication technique for projecting a human presence to a distant place. Of course, it is not necessary to use perfectly humanlike robots. We expect to identify the essential factors of humanlike presence through these cognitive studies, enabling us to design minimal robot systems which can still convey humanlike presence effectively.

【References by the principal investigator】

- Hiroshi Ishiguro, Scientific issues concerning androids, International Journal of Robotics Research (Impact Factor 2005: 1.127), Vol. 26, No. 1, pp. 105-117, 2007.
- Hiroshi Ishiguro, Android Science, Studies on robotics for understanding human, Mainichi Communications, 2007.

【Term of project】 FY2008－2012	【Budget allocation】 161,700,000 yen (direct cost)

【Homepage address】 http://www.ed.ams.eng.osaka-u.ac.jp/research/0012/index.en.html

Awareness, self-reflection, and mind-reading: Genesis and functions of cognitive meta-processes.

Kazuo Fujita
(Kyoto University, Graduate School of Letters, Professor)

【Outline of survey】

In this project, we aim to unveil mechanisms of understanding others (mind-reading) by empirical studies of phylogeny and ontogeny of introspective cognition such as awareness and self-reflection (cognitive meta-processes). We hypothesize that understanding self underwrites understanding others. We plan to conduct behavioral observations and tests of a wide variety of animals including humans, nonhuman primates, carnivores, ungulates, rodents, and birds in evolutionary and developmental perspectives for their potential to show functions such as meta-memory (memory of memory) and information-seeking behavior, recognition of confidence and risk selection, episodic memory and future planning, recognition and control of affect, and empathy and understanding other's behavior. Recent studies have shown that several nonhuman species may possess some of the meta-processes and thus language is not necessary before possessing them. This project is the first systematic study toward general understanding of meta-processes that remain to be one of the most important aspects in knowing what humans are.

【Expected results】

We will be able to make a sketch of how cognitive meta-processes have evolved and develop in ontogeny and hope to identify what meta-processes are necessary before acquiring aspects of mind-reading. Establishing methodology to study meta-processes contributes to neuroscientific inverstigation of these higher functions. Demonstration of meta-processes in various organisms may drastically change current views of humans, infants, and nonhumans, which in turn may enhance respect to lives and consciousness to global symbiosis, and promotes suggestions for the globalized future. Identification of meta-processes necessary to understanding others will contribute to support people who have deficit in this function and might help developing mind-reading robots.

【References by the principal investigator】

- Fujita, K. (2007) Doubutsu tachi no yutaka na kokoro (The wealth of Nonhuman animal minds). Kyoto University Press. 181pp. (in Japanese)
- Fujita, K., & Itakura, S. (eds.) (2006) *Diversity of Cognition: Evolution, Development, Domestication, and Pathology*. Kyoto University Press. 414pp.

【Term of project】 FY2008－2012	【Budget allocation】 143,300,000 yen (direct cost)

【Homepage address】 http://www.bun.kyoto-u.ac.jp/~kfujita/

Brain mechanisms of dynamic image generation based on body schema

Toshio Inui

(Kyoto University, Graduate School of Informatics, Professor)

【Outline of survey】

It has been suggested that the parietal cortex and hippocampus, which play an important role in embodied cognition, are involved in the dynamic operation of mental imagery in various cognitive processes, such as object recognition, language comprehension, and social communication. However, it remains unclear how the networks including these brain areas are involved in the processes of image generation, transformation, and matching. Therefore, the present study elucidates the dynamics of neural networks for the following two functions:
(1) image generation, transformation, and matching processes in object recognition
(2) the dynamic image generation and transformation processes on cognitive maps
We will clarify the commonalities and differences between characteristics of object recognition and cognitive map and investigate how these functions are realized based on a body schema. In addition to the experimental and modeling researches, a new technique for simultaneously recording fMRI and electroencephalographic data was developed in order to clarify the brain network dynamics.

【Expected results】

The importance of generating and transforming mental images in the acquisition of the cognitive function in the first two or three years of life is accepted. Furthermore, mental image processing plays an important role in various medical treatments for clinical psychological disorders, including hypnotic induction. Furthermore, it is noted that disturbance in the function of mental imagery is a critical factor in mental disorders, including depersonalization. Therefore, in terms of human communication and education, it is extremely important to elucidate the underlying mechanisms in the nervous system involving generation and transformation of mental images. Furthermore, our research will contribute to the fields of cognitive robotics and human-robot interaction.

【References by the principal investigator】

- Imazu, S., Sugio, T., Tanaka, S., and Inui, T. (2007) Differences between actual and imagined usage of chopsticks: An fMRI study. Cortex, 43, 301-308.
- Ogawa, K., and Inui, T. (2007) Lateralization of the posterior parietal cortex for internal monitoring of self- versus externally generated movements. Journal of Cognitive Neuroscience, 19, 1827-1835.

【Term of project】 FY2008－2012	【Budget allocation】 162,000,000 yen (direct cost)

【Homepage address】 http://www.cog.ist.i.kyoto-u.ac.jp/

The Elucidation of Sign Language Acquisition Mechanism Based on the Linguistic Function of the Brain

Kuniyoshi L. Sakai

(The University of Tokyo, Graduate School of Arts and Sciences, Associate Professor)

【Outline of survey】

The core issue in the linguistic function of the brain is acquisition of the native language. However, the main process of language acquisition occurs within several years after the birth, and intervention in this process is forbidden on ethical grounds. In addition, the functional brain imaging of infants is impeded by the physical restraints necessary to control head and body movement. In order to overcome this problematic situation, we would like to suggest a new line of research designed to reveal the sign language acquisition mechanism. In Japan at present, it is not adequately understood that sign language is the only natural native language for children with hearing impairment. Therefore, in order to protect the language rights of these children, it is necessary that we intervene in such a way that they have the opportunity to acquire sign language. Considering that language ability is the basis for all forms of study and education, there is no doubt that establishment of language ability itself is the key to resolve the fundamental problem. Therefore, we would like to elucidate the linguistic function of the brain in the language development of children with hearing impairment in order to clarify the processes and mechanisms of syntax, semantics, and phonemes (e.g. rhythm in sign language), and to establish the causal relations between these various factors and learning abilities. The goal of this study is to combine the development of an objective method, which can evaluate both language and learning abilities of Deaf children, and the measurement of the brain activities of native signers and learners of Japanese Sign Language with fMRI (functional magnetic resonance imaging) or MEG (magnetoencephalography), thereby allowing quantitative assessment of the functional localization of language processing and the degree of learning accomplishment.

【Expected results】

If a child with hearing impairment does not live in an appropriate linguistic environment, not only will the child's language development be retarded, but the child's overall learning will be delayed, with the result that he or she may not be able to acquire or develop the intelligence necessary for life in society. We can expect that it will be demonstrated empirically that hearing impaired children, even those with severe hearing impairment, can acquire linguistic ability and learning activity using sign language in the normal developmental process, if they are allowed to acquire Japanese Sign Language as their native language as early as possible. This study is the first step for data accumulation toward the realization of the education and life support program for people with hearing impairment through both a functional brain imaging study and an investigational study tolerable to the detailed statistical assessments.

【References by the principal investigator】

・Sakai, K. L.: Language acquisition and brain development. *Science* **310**, 815-819 (2005).
・Sakai, K. L., Tatsuno, Y., Suzuki, K., Kimura, H. & Ichida, Y.: Sign and speech: Amodal commonality in left hemisphere dominance for comprehension of sentences. *Brain* **128**, 1407-1417 (2005).

【Term of project】 FY2008－2012	【Budget allocation】 **113,100,000 yen** (direct cost)

【Homepage address】 http://mind.c.u-tokyo.ac.jp/

Analyses of architecture and functions of cerebral networks by target neuron-selective activity suppression and tract-tracing approaches

Masahiko Takada

(Tokyo Metropolitan Organization for Medical Research, Tokyo Metropolitan Institute for Neuroscience, Staff Scientist & Director)

【Outline of survey】

To elucidate the basic framework of complex and fine neural networks in the brain is very important for understanding a wide variety of brain functions based on the networks. Especially, it is essential to know about the mode of information processing in circuits linking the cerebral cortex (i.e., the frontal lobe) and the basal ganglia. The present study is designed to analyze the architecture and functions of the cortico-basal ganglia circuits or their component neurons. One attempt is made to develop a methodological approach to target neuron-selective activity suppression with a new lentiviral vector system in primates, thus examining changes in behavioral pattern and neuronal activity in response to motor and cognitive tasks. Another attempt is made to establish an anatomical system for target neuron-selective retrograde transneuronal tract-tracing with a recombinant rabies viral vector, thereby investigating multisynaptic inputs to a particular neuronal population.

【Expected results】

Our original approach enables us to not only perform target neuron-selective retrograde transneuronal tract-tracing by means of a recombinant rabies viral vector,but also achieve target neuron-selective activity suppression with the aid of a recently developed lentiviral vector pseudotyped with the envelope protein of rabies virus. The outcome of the present study is novel and crucial to clarify the architecture of cortico-basal ganglia networks involved in higher brain functions.

【References by the principal investigator】

- Kato, S., Inoue, K., Kobayashi, K., Yasoshima, Y., Miyachi, S., Inoue, S., Hanawa, H., Shimada, T., Takada, M., Kobayashi, K. (2007) Efficient gene transfer via retrograde transport in rodent and primate brains by an HIV-1-based vector pseudotyped with rabies virus glycoprotein. **Hum. Gene Ther.**, 18:1141–1151.
- Miyachi, S., Lu, X., Inoue, S., Iwasaki, T., Koike, S., Nambu, A., Takada, M. (2005) Organization of multisynaptic inputs from prefrontal cortex to primary motor cortex as revealed by retrograde transneuronal transport of rabies virus. **J. Neurosci.**, 25:2547–2556.

【Term of project】 FY2008–2012	【Budget allocation】 **127,700,000 yen** (direct cost)

【Homepage address】 http://www.tmin.ac.jp/index.html

Study of IP_3 receptor/Ca^{2+} signaling in neural plasticity and brain development and differentiation

Mikoshiba, Katsuhiko

(RIKEN, Brain Science Institute, Group Director)

【Outline of survey】

Biophysical and biochemical studies of the molecular properties of IP_3Rs helped us realize that various mechanisms contribute to the fine-tuning of IP_3R-mediated Ca^{2+} signal. These mechanisms equip different isoforms, assemble various IP_3R-associated molecules, or dynamically change in the subcellular localization of the signal. The discovery of many kinds of binding partners suggests that IP_3Rs form a macro signal complex and function as a center of multiple signaling cascades. The diversity of Ca^{2+} signaling patterns and/or subcelullar distribution mechanisms of IP_3Rs most likely are a product of the components of IP_3Rs-signaling complex, which can differ from cell to cell, and even from subcellular space to subcellular space.

Our final goal is to understand the precise role of IP_3R-mediated Ca^{2+} signaling in recognition, learning and memory, and consciousness. By focusing our study on the regulation of IP_3R-mediated Ca^{2+} signaling by these various mechanisms described, we will elucidate the molecular basis of IP_3R function in a series of brain development process and brain function. To achieve this, our approach to the study of IP_3Rs needs to remain diverse, especially when looking at IP_3Rs as in a signaling complex.

【Expected results】

We will focus on uncovering the function and physiological roles of IP3Rs, to understand the role of IP3Rs-mediated Ca^{2+} signaling in recognition, learning, and memory. Using the latest imaging methods, (e.g. fluorescent resonance energy transfer (FRET), Quantum Dots, a single molecule imaging technique), we will clear the relationship of dynamics of molecular interaction and biological phenomena. We also expect that we understand the molecular mechanism of diseases caused by abnormality of influx along the elucidation of physiological function of IP_3 receptor.

【References by the principal investigator】

- Ando, H., Mizutani, A., Kiefer, H., Tsuzurugi, D., Michikawa,T. & Mikoshiba, K.: IRBIT suppresses IP_3 receptor activity by competing with IP_3 for the common binding site on IP_3 receptor in a phosphorylation-dependent manner. **Molecular Cell** 22 795-806 (2006)
- Shirakabe, K., Priori, G., Yamada, H., Ando, H., Horita, S., Fujita, T., Fujimoto, I., Mizutani, A., Seki, A. & Mikoshiba, K.: IRBIT specifically binds to and activates pancreas-type Na^+/HCO_3^- cotransporter 1, pNBC1. **Proc. Natl. Acad. Sci.** 103(25) 9542-9547 (2006)

【Term of project】 FY2008− 2012	【Budget allocation】 **159,700,000 yen** (direct cost)

【Homepage address】 Under construction

Neuronal identification by fluorescence spectrogram, and the application to auditory neural circuits in vivo

Harunori, Ohmori
(Kyoto University, Graduate School of Medicine, Professor)

【Outline of survey】

This project tries identifying molecular characteristics of neurons by detecting fluorescence that is evoked through a quartz glass electrode; then by using the same glass electrode the electrical activity of the neuron will be recorded. We are particularly interested in the function of inhibitory neurons in the auditory brain activity. Inhibitory neurons are expected to regulate variety of neuronal activities. However, exact roles of inhibitory neurons were not much known because of the difficulty of differentiating activities of them from those of excitatory neurons. On the other hand, a genetically engineered mouse is already available which has GFP labeled on inhibitory neurons. Therefore, this research project aims first to identify these GFP labeled inhibitory neurons in the auditory midbrain nuclei by fluorescence spectrogram. Although the methodology could be expanded widely in the analyses of fluorescence labeled neurons such as FRET molecules in the brain, we will first apply this method in the investigation of the roles of GFP labeled inhibitory neurons in auditory circuits on which we have a lot of experience.

【Expected results】

This research will develop a methodology to detect molecular identity of neurons in vivo by fluorescence spectrogram; then electrophysiological experiments will be conducted on the identified neurons. The strategy will facilitate the functional understanding of neural circuits in the brain. The technique will also facilitate experimental usage of already made many genetically engineered mice which have fluorescence labeled neurons such as by GFP and FRET molecules. Overall, the outcome of recent advancement of molecular biology will be effectively adopted in neurophysiological researches in the brain, and will facilitate our understanding of the brain.

【References by the principal investigator】

・Kenji Takatsuka et al (2005). A novel Ca2+ indicator protein using FRET and calpain-sensitive linker. Biochemical and Biophysical Research Communications 336: 316-323.
・Nishino E et al (2008).Sound intensity-dependent compensation for the small interaural time difference cue for sound source localization. Journal of Neuroscience (in press)

【Term of project】 FY2008－2012	【Budget allocation】 127,100,000 yen (direct cost)

【Homepage address】 http://www.nbiol.med.kyoto-u.ac.jp/

Establishment of a IL-1-related gene manipulated mouse library to understand diseases from a systems biological view point

Yoichiro Iwakura

(The University of Tokyo, The Institute of Medical Science, Professor)

【Outline of survey】

Cytokines are messenger molecules that are secreted by various cells and transfer information among cells. They are good therapeutic targets, because they play important roles in maintaining homeostasis of the body as well as in the development of various diseases. Because many genes are involved in the development of these diseases, systematic approaches are required to understand the molecular pathogenesis. In this study, we are planning to generate gene manipulated mice related to IL-1 to elucidate functions of these genes in a living animal, because IL-1 plays a central role in the immuno-neuro-endocrine system and is involved in various diseases such as infectious diseases, immune disorders, diabetes and stress responses. We are also planning to distribute these mice to promote researches in these fields.

【Expected results】

By generating gene manipulated mice systematically, not only we can analyze the roles of a particular gene in the development of diseases, but also we can analyze the relationship among genes. This kind of knowledge should allow us a system biological approach to develop a novel therapeutics to many immunological, neurological, and endocrinological diseases. We are also pretty confident about the usefulness of these gene manipulated mice in the researches in the related fields.

【References by the principal invdestigator】

・Fjikado, N, Saijo, S, Yonezawa, T, Shimamori, K, Ishii, A, Sugai, S, Kotaki, H, Sudo, K, Nose, M, and Iwakura, Y. DCIR deficiency causes development of autoimmune diseases in mice due to excess expansion of dendritic cells. *Nature Med.*, **14**, 176-180, (2008)

・Saijo, S., Fujikado, N., Furuta, T., Chung, S., Kotaki, H., Seki, K., Sudo, K., Akira, S., Adachi, Y., Ohno, N., Kinjo, T., Nakamura, K., Kawakami, K., and Iwakura, Y. Dectin-1 is required for host defense against Pneumocystis carinii but not against Candida albicans. *Nature Immunol.*, **8**, 39-46 (2007).

・Ishigame, H., Nakajima, A., Saijo, S., Komiyama, Y., Mastuki, T., Nakae, S., Horai, R., Kakuta, S., and Iwakura, Y. The role of TNFα and IL-17 in the development of excess IL-1 signaling-induced inflammatory diseases in IL-1 receptor antagonist-deficient mice. *Ernst Schering Res. Found. Workshop*, **56**, 129-153 (2006)

・Iwakura, Y., and Ishigame, H. The IL-23/IL-17 axis in inflammation. *J. Clin. Invest.*, **116**, 1218-1222 (2006).

【Term of project】 FY2008− 2011	【Budget allocation】 **78,100,000 yen** (direct cost)

【Homepage address】 http://www.ims.u-tokyo.ac.jp/cem_dcb/index.html

Development of Technology to Manipulate the Biological Functions of Stem cells for Cell therapy of Next Generation

Yasuhiko Tabata

(Kyoto University, Institute for Frontier Medical Sciences, Professor)

【Outline of survey】

There are two approaches to realize the therapy of regenerative medicine : tissue regeneration and repairing by cell transplantation and tissue engineering where the proliferation and differentiation of cells are promoted by biomaterials and biomedical technologies to induce the regeneration and repairing of tissues. The objective of this project is to develop the technology of tissue engineering for enhancement of the biological functions of stem cells aiming at promoted efficacy of cell therapy. Biomaterials of gene transfection for stem cells and the technologies of cell culture are both developed to manipulate and enhance the biological functions of cells. The functions of stem cells genetically manipulated by efficient combination of transfection biomaterials and culture technologies are investigated in vitro and in vivo. The results obtained are indispensable for the future development of tissue regenerative therapy. This is because the results are practically applicable for the basic research of stem cells biology and medicine as well as their therapeutic applications. In this project, the biomaterials of non-viral gene transfection for stem cells are investigated and developed as the viral system cannot be clinically applied. In addition, the improvement of cell culture substrates and technology/methodology is actively carried out to provide stem cells with good culture conditions which greatly affect the efficiency of gene transfection. Efficient manipulation of stem cells for their biological activation can be achieved by the substantial research integration of gene transfection and cell culture technologies.

【Expected results】

Even if stem cells can be obtained accompanied with the recent advance of cells researches, it is practically impossible to enhance the therapeutic efficacy of cell transplantation without the improvement and development of technology and methodology to increase the grafting rate of cells transplanted. The achievement of this project will result in the increased grafting rate of cells transplanted and the consequent enhancement of their therapeutic efficacy, which is one of the large and important steps to realize the cell therapy of next generation. The technology of cells manipulation developed can be applied for stem cells which are practically difficult to genetically engineer their biological functions. In addition, the technology is also useful to clarify the mechanism of cells differentiation and achieve the differentiation regulation as well as the research for the design and creation of drugs.

【References by the principal investigator】

・Y. Tabata. Current status of regenerative medical therapy based on drug delivery technology. Regenerative BioMedicine Online, 16(1), 70-80(2008)
・M. Yamamoto and Y. Tabata. Tissue engineering by modulated gene delivery. Advanced Drug Delivery Reviews, 58, 535-554 (2006)

【Term of project】 FY2008－2012	【Budget allocation】 129,400,000 yen (direct cost)

【Homepage address】 http://www.frontier.kyoto-u.ac.jp/te02/index-j.php3

Study on a Primary Conservation System for Sustainable Access and Preservation of the Cultural Heritage in Museums

Nobuyuki Kamba, Ph.D.
(National Institutes for Cultural Heritage,
Tokyo National Museum,Curatorial Research Department,
Supervisor of Conservation)

【Outline of survey】

It is the purpose that this research does the study and development about a primary care system which are the new conservation technique of the cultural heritage which put the base on the viewpoint of clinical science. By integrating clinical conservation and the data generated from the activity, it is enabling the safe exhibition and the preservation which controlled the risk to the minimum.

It becomes possible to control the interactions such as climate control, a degradation phenomenon of a cultural heritage, and management of man efficiently by the research. Access and control to a cultural heritage attract attention as a contemporary subject. This research has its original view point of creating the theory and the structure of the system for detecting the optimal relations of them.

【Expected results】

The research will give very high safety and durability to the conservation and exhibition of the cultural heritage of 120,000 sets of objects of the Tokyo National Museums. Next, by a primary conservation system, the conservation philosophy and the methodology for establishing safe exhibition and the optimal preservation are offered under the situation such as a high risk exists in museum management today. By raising a next-generation preservation system, a museum will inherit a cultural heritage in the future, and will continue as a core place which aims at communication with society.

【References by the principal researcher】

・Kamba, N., ‘Hakubutukan Kankyou No Manejimento’, Bunkazaino No Hozon To Syufuku 10, Ed. The Japan Society for the Conservation of Cultural Property, Kubapuro, pp33‐40, 2008
・Kamba, N., ‘Primary Care and Practice of Conservation’, International Symposium Proceedings of Practice of Conservation in Museums, Ed. Tokyo National Museum, pp104-116, 2007
・Kamba, N., ‘The fundamental Principle of Preventive Conservation in the Preservation of Cultural Properties in Tokyo National Museum’, MUSEUM, No.594, pp61-77, 2005

【Term of project】 FY2008－2012	【Budget allocation】 76,200,000 yen (direct cost)

【Homepage address】 http://www.tnm.jp

Global mapping and monitoring of sea ice production

Kay I. Ohshima
(Hokkaido University, Institute of Low Temperature Science, Professor)

【Outline of survey】

Deep ocean circulation is driven by density differences: water sinks in dense water formation areas and then gradually upwells in other areas. Saline water rejected during sea ice formation is the main source of dense water, and thus sea ice production is a key factor in deep ocean circulation. Due to the logistic difficulties of direct observations, climatologies of sea ice production and its interannual variability have yet to be presented. We will conduct mooring observations in high sea ice production areas (coastal polynyas) in the Antarctic, Arctic and Okhotsk Seas to acquire a continuous dataset of sea ice thickness/driftand ocean temperature/salinity, which has not been obtained concurrently in the past. Using these validation data, we will develop an algorithm to estimate and provide global mapping of sea ice production from satellite data. We plan to establish a monitoring system for sea ice production by combining continuous mooring and satellite observations. We will also clarify the relationship between the variability of sea ice production and deep ocean circulation.

【Expected results】

From direct observations we can clarify a previously unknown formation area of Antarctic Bottom Water suggested by our preliminary study. The dataset in this project enables us to discuss how sea ice variability is linked with recent freshening and density decreases in Antarctic Bottom Water and Okhotsk Sea Intermediate Water, and the associated weakening of overturning in the deep ocean. Changes in deep ocean circulation will greatly affect global climate and ecosystems. This is the first global mapping of sea ice production, which can be used for comparison/validation with coupled ocean-ice-atmosphere models. The mapping also provides surface heat and salt flux conditions in the sea ice covered regions, which have not been clearly understood.

【References by the principal investigator】

・Tamura, T., K. I. Ohshima, and S. Nihashi, Mapping of sea ice production for Antarctic coastal polynyas, *Geophys. Res. Lett., 35*, L07606, doi:10.1029/2007GL032903, 2008.
・Ohshima, K.I., T. Watanabe, and S. Nihashi, Surface heat budget of the Sea of Okhotsk during 1987-2001 and the role of sea ice on it, *J. Meteor. Soc. Jpn,, 81*, 653-677, 2003

【Term of project】 FY2008－2012	【Budget allocation】 **162,400,000 yen** (direct cost)

【Homepage address】 http://wwwod.lowtem.hokudai.ac.jp/~ohshima/

Direct observations of tidal mixing and studies on ocean/climate variability synchronized with 18.6-year period nodal tidal cycle

Ichiro Yasuda

(The University of Tokyo, Ocean Research Institute, Professor)

【Outline of survey】

The goals of this project are to directly observe strong tidal mixing in the North Pacific subarctic regions, to elucidate the impact on ocean circulation, material circulation and biological productivity and to evaluate the influence of the 18.6-year period nodal tidal cycle on the ocean and climate. To achieve these, we will 1) perform observations of turbulence, currents, nutrients and planktons in the oceanic areas as Kuril, Okhotsk Sea, Kamchatka, Aleutian, Bering Sea and the Kuroshio Extension, where strong tidal mixing is expected to occur, and try to quantify the tidal mixing with combining models and theories, 2) examine historical observational data and study on the relation with 18.6-year period nodal tidal cycle. By developing 3) ocean and 4) climate numerical models with tidal mixing observed in the North Pacific subarctic regions, impacts of tidal mixing and 18.6-year cycle on the ocean circulation, ecosystem and climate are evaluated.

【Expected results】

In the North Pacific ocean and atmosphere, bi-decadal variability is known to be dominated on the inter-decadal time-scales; however, causes remain to be a mystery. The hypothesis of the present project that “18.6-year period tidal cycle regulates the bidecadal variability in the ocean/climate” is a possible candidate to resolve the mystery. If the hypothesis can be evidenced, predictability could be greatly improved because the tidal cycle is accurately predictable. Observational data obtained in this project as directly measured ocean turbulence data down to intermediate and deep oceans in association with physical, chemical and biological studies will greatly contribute to understanding of ocean thermohaline circulation, material circulation and marine ecosystem.

【References by the principal investigator】

・**I. Yasuda**, S. Osafune and H. Tatebe, 2006: Possible explanation linking 18.6-year period nodal tidal cycle with bi-decadal variations of ocean and climate in the North Pacific. *Geophys. Res. Letters*, 33, L08606, doi:10.1029/2005GL025237.

・S. Osafune, and **I. Yasuda**, 2006: Bidecadal variability in the intermediate waters of the northwestern subarctic Pacific and the Okhotsk Sea in relation to 18.6-year period nodal tidal cycle. *J. Geophys. Res.*, 111, C05007, doi:10.1029/2005JC003277.

【Term of project】 FY2008－2012	【Budget allocation】 163,700,000 yen (direct cost)

【Homepage address】 http://lmr.ori.u-tokyo.ac.jp/feog/FODeng.html

Environmental Contamination and Ecological Risk of Novel POPs in the Asian Developing Region

Shinsuke Tanabe
(Ehime University, Center for Marine Environmental Studies, Professor)

【Outline of survey】

The new candidates of persistent organic pollutants (Novel POPs) such as brominated flame retardants, perfluorinated chemicals etc. are of growing consideration academically and socially on their increasing environmental contamination and temporal trends. While the environmental monitoring and risk assessment of Novel POPs have been widely conducted in developed nations, less information is available on the status of contamination in developing countries. Several environmental problems originating from irregular dumping of electrical and municipal wastes have been recently documented in the Asian developing countries with high economic growth, and hence the environmental contamination and toxic effects by Novel POPs are of concern in this region. The present study aims at elucidating the status of environmental contamination, pollution sources like open municipal and electrical waste dumping sites, bioaccumulation in human and wildlife, toxic effects and risk assessment, and historical and future trends of contamination by Novel POPs in the Asian developing region.

【Expected results】

The achievements of this study are highly expected to provide scientific evidences for promoting environmental management in developing countries and for reducing global pollution and ecological risk with respect to Novel POPs. The scientific evidences obtained in this project will also contribute for smooth implementation of POPs treaty and the reasonable political discussion on Novel POPs, which is necessary for conceiving an agreement in choosing additional POPs, and their monitoring and control measures.

【References by the principal investigator】

- Tanabe, S. (2007): Contamination by persistent toxic substances in the Asia-Pacific region. Persistent Organic Pollutants in Asia: Sources, Distributions, Transport and Fate, Li, A., Tanabe, S., Jiang, G., Giesy, J. P. and Lam, P. K. S. (Eds), Elsevier, pp.773-817.
- Tanabe, S. and Subramanian, A. (2006): Bioindicators of POPs -Monitoring in Developing Countries-, Kyoto University Press & Trans Pacific Press, 190p.

【Term of project】 FY2008－2012	【Budget allocation】 125,100,000 yen (direct cost)

【Homepage address】 http://www.ehime-u.ac.jp/~cmes/tanabe/index.html

Investigation of Mechanical Manipulation of Atoms and Molecules on Insulator Surfaces with Extreme Field Atomic Force Microscopy

Yasuhiro Sugawara
(Osaka University, Graduate School of Engineering, Professor)

【Outline of survey】

The purpose of the present project is to develop the unexplored techniques of mechanically manipulating atoms and molecules on insulator surfaces as well as to investigate of the physical properties of the assembled nano-structures, with the noncontact atomic force microscopy operating under extreme fields such as low temperatures, high magnetic fields and ultrahigh vacuum. The details of the projects are as follows.

1) Clarification of the control conditions and the mechanism to mechanically manipulate atoms and molecules on insulator surfaces.
2) Assembling the nano-structures and clarification of the physical properties.
3) Mechanical manipulation of magnetic atoms in high magnetic fields and clarification of the magnetic interaction.
4) Investigation of novel spin states of electrons for assembled magnetic nano-structures.

【Expected results】

This project is expected to open a novel research field concerned with the manipulation/assembly of atoms and molecules in insulator surfaces. In addition, the results of this project are expected to offer key technologies in a wide variety of fields related to the nanotechnology. Furthermore, the manipulation of magnetic atoms enables us to assemble new magnetic nano-structures. By investigating the physical properties of the nano-structures, we can get knowledge for the quantum spin states of electrons in the nano-structures. Such knowledge will bring a huge contribution to the progress of the spintronics (spin-based electronics) which controls the quantum spin states of electrons.

【References by the principal investigator】

- Y. Naitoh, K. Momotani, H. Nomura, Y. J. Li, M. Kageshima, and Y. Sugawara: *J. Phys. Soc. Jpn.*, 76, 2007, 033601(4pages).
- Y. J. Li, H. Nomura, N. Ozaki, Y. Naitoh, M. Kageshima, Y. Sugawara, C. Hobbs and L. Kantorovich: *Phys. Rev. Lett.*, 96, 2006, 106104(3pages).
- Y. Sugawara: "Applied Scanning Probe Methods VI", e*d. by B. Bhushan, H. Fuchs, S. Kawata,* Springer, 2006, Chapter 18, 247-255.

【Term of project】 FY2008－2012	【Budget allocation】 **70,900,000 yen** (direct cost)

【Homepage address】 http://www.eng.osaka-u.ac.jp/ap1/g3/sugawaralab/

Dynamic Control of Slide-Ring Materials

Kohzo Ito

(The University of Tokyo, Graduate School of Frontier Sciences, Professor)

【Outline of survey】

Since the discovery of cross-linking in natural rubber with sulfur in 1839 by Goodyear, the cross-linking of polymeric materials has been one of the most important research subjects in polymer science and technology. We have recently developed a novel kind of cross-linked polymeric materials called *slide-ring materials* using *polyrotaxane*, the supramolecular architecture with topological characteristics. The slide-ring materials have figure-of-eight cross-linking junctions that can move freely in a polymer network. As a result, they show mechanical properties quite different from conventional cross-linked polymeric materials with fixed junctions.

In this project, we synthesize various polyrotaxanes of different axis polymer chains to create new slide-ring materials with controllable movements of cyclic molecules in polyrotaxanes. Then we aim to explore new properties and functions of the slide-ring materials and reveal the molecular mechanism by investigating the correlation between the nanoscopic sliding mode and macroscopic mechanical dynamics. This project will lead to the establishment of new field in polymer science on the basis of the novel concept of the freely movable cross-linking junction in a polymer network.

【Expected results】

By proposing a new theoretical model describing the slide-ring materials and finding new properties and functions based on the sliding mode, the project will yield a new area and bring large progress in polymer science. In addition, it will urge innovation to polymeric materials such as textiles, paints, films, adhesion, coating, biomaterials and so on since we will develop novel slide-ring materials with controllable dynamic properties in this project that have been not observed in conventional materials.

【References by the principal investigator】

- Y. Okumura and K. Ito; “The polyrotaxane gel: a topological gel by figure-of-eight cross-links”, *Advanced Materials*, **13**, 485-487(2001).
- J. Araki and K. Ito, “Recent advances in the preparation of cyclodextrin-based polyrotaxanes and their applications to soft materials”, *Soft Matter*, **3**, 1456-1473(2007).

【Term of project】 FY2008－2012	【Budget allocation】 **155,900,000 yen** (direct cost)

【Homepage address】 http://www.molle.k.u-tokyo.ac.jp/

Innovative High-speed AFM for Elucidating Vital Phenomena

Toshio Ando

(Kanazawa University, Graduate School of Natural Science and Technology, Professor)

【Outline of survey】

"Dynamics" is one of intrinsic properties of biological molecules. Thus far, measurements of dynamic phenomena, which take place at the molecular and cellular levels, have mainly been performed by fluorescence microscopy. Although new fluorescence microscopy that breaks the diffraction limit has already been materialized, in principle it is never able to visualize biological molecules themselves. We have developed a high-speed atomic force microscope and succeeded in capturing dynamic behaviors of protein molecules on video. The functional mechanisms of some protein systems have been revealed by the imaging. However, with the current high-speed AFM, the tip-sample interaction force is small but not negligible to very delicate samples. As the membranes of live cells are extremely soft, they are deformed by the interaction force, and therefore, molecular processes occurring thereon cannot be imaged. Imaging intracellular structures is even more beyond the microscope. In the present study, we extend the capability of our high-speed AFM to develop a high-sensitive/high-speed AFM, a high-speed non-contact AFM, and a high-speed diaphano-AFM.

【Expected results】

By the aforementioned development, it will become possible to observe dynamic processes of very delicate samples without disturbing their functions. It will enable observing dynamic biomolecular processes occurring on live cell membranes, such as dynamic behaviors of receptors as they bind to ligands and opening/closing of ionic channels. In addition, it will enable observing dynamic behaviors of intracellular organelles such as nuclei and Golgi bodies. By materializing non-contact imaging, the imaging rate will be increased higher than the current rate of 30-60 ms/frame.

【References by the principal researcher】

- T. Ando, T. Uchihashi, N. Kodera, D Yamamoto, M. Taniguch, A. Miyagi, and H. Yamashita, Invited Review: High-speed AFM and nano-visualization of biomolecular processes. *Pflügers Archiv - Eur. J. Physiol*. **456**: 211-225 (2008).
- T. Ando, T. Uchihashi, N. Kodera, A. Miyagi, R. Nakakita, H. Yamashita, and M. Sakashita, High-speed atomic force microscopy for studying dynamic behavior of protein molecules at work. *Jpn. J. Appl. Phys*. **45**(3B):1897-1903 (2006).

【Term of project】 FY2008－2012	【Budget allocation】 **149,800,000 yen** (direct cost)

【Homepage address】 http://www.s.kanazawa-u.ac.jp/phys/biophys/index.htm

Development of a nano-SQUID and its application to quantum information

Hideaki Takayanagi

(Tokyo University of Science, Research Institute for Science and Technology, Professor)

【Outline of survey】

A SQUID is one of the most sensitive detector for magnetic field. Our goal is to develop ultra small SQUIDs and to apply them to the following research subjects.

① Detection of single spin and study of relaxation process of spin using nano-SQUID whose size is less than μm.

② Implementation of quantum entanglement between a SQUID-qubit and a spin-qubit.

We will fabricate a coupling system between semiconductor-2DEG or quantum dots and a nano-SQUID which is fabricated by mechanical etching using focused ion beam or by a previous Josephson-junction method. The spin detection can be made through the high-speed measurement of the maximum supercurrent in a nano-SQUID. For the second subject we will first develop a nano-SQUID embedded with a quantum dot and confirm its qubit operation. Then quantum entanglement is achieved by a direct coupling between a superconducting flux qubit and the nano-SQUID or by a coupling between them through a LC-resonator.

【Expected results】

There are very few experiments on the detection of single spin or spin relaxation process. Nano-SQUID system that we work on will clarify physical origin of spin relaxation process in various kind of systems like quantum dot, graphene or 2DEG. The nano-SQUID thus is a very strong tool to contribute on the development of spintronics and spin-qubit. The coupling between different kind of qubits (like a flux qubit and spin one) is the basis for the quantum interface which is one of the key technologies for the future quantum information network.

【References by the principal investigator】

・J. Johannson, S. Saito, T. Meno, H. Nakano, M. Ueda, K. Semba and H. Takayanagi, "Vacuum Rabi Oscillations in a Macroscopic Superconducting Qubit LC Oscillator System", Phys Rev. Lett. **96**, 127006 (March, 2006).

・S. Sasaki, S. Kang, K. Kitagawa, M. Yamaguchi, S. Miyashita, T. Maruyama, H. Tamura, T. Akazaki, Y. Hirayama, and H. Takayanagi, "Non-local Control of the Kondo Effect in a Double Quantum Dot - Quantum Wire Coupled System", Phys. Rev. B Rapid Commun. **73** (2006) 161303-1 - 161303-1 (R).

【Term of project】 FY2008－2012	【Budget allocation】 160,100,000 yen (direct cost)

【Homepage address】 http://www.rs.kagu.tus.ac.jp/~takalab/

Fathoming the evolution of gene regulation through an 'arms race' between transposons and Argonautes

Haruhiko Siomi

(Keio University, School of Medicine, Professor)

【Outline of survey】

Transposable elements (TEs) are powerful mutagenic agents responsible for generating variation in the host genome. As TEs can be overtly deleterious, a variety of different mechanisms have evolved to keep their activities in check. Recent evidence has linked RNA silencing with inhibition of expression and transposition of TEs. RNA silencing is an evolutionarily conserved mechanism in which small RNAs trigger various forms of sequence specific gene silencing by guiding Argonautes to target RNAs via base-pairing. It is becoming increasingly clear that the "arms race" between TEs and hosts leads to positive selection for cellular defense mechanisms, part of which are co-opted for evolving new regulatory circuits, thus enabling the integration and networking of complex suites of gene activity. Using a combination of biochemistry and genetics, we will seek to fill gaps in our understanding of the biochemical events that transpire in this "arms race", which has the potential to create diversification of gene expression in hosts.

【Expected results】

In the coming years, results from this project would provide clear links between TE silencing by RNA silencing pathways and regulation of the expression of specific cellular genes. Recent studies have shown that RNA silencing is implicated in human disease such as fragile X syndrome. Thus our studies would also provide links between RNA silencing and human disease.

【References by the principal investigator】

1. Ishizuka, A., Siomi, MC. and Siomi, H. 2002. A Drosophila fragile X protein interacts with components of RNAi and ribosomal proteins. *Genes Dev* 16: 2497-2508.
2. Okamura, K., Ishizuka, A., Siomi, H., and Siomi, MC. 2004. Distinct roles for Argonaute proteins in small RNA-directed RNA cleavage pathways. *Genes Dev* 18: 1655-1666.
3. Saito, K., Nishida, KM., Mori, T., Kawamura, Y., Miyoshi, K., Nagami, T., Siomi, H., and Siomi, MC. 2006. Specific association of Piwi with rasiRNAs derived from retrotransposon and heterochromatic regions in the Drosophila genome. *Genes Dev* 20: 2214-2222.
4. Gunawardane, LS., Saito, K., Nishida, KM., Miyoshi, K., Kawamura, Y., Nagami, T., Siomi, H., and Siomi, MC. 2007. A Slicer-mediated mechanism for rasiRNA 5'end formation in *Drosophila*. *Science* 315: 1587-1590.
5. Kawamura, Y., Saito, K., Kin, T., Ono, Y., Asai, K., Sunohara, T., Okada, NT., Siomi MC. & Siomi, H. 2008. *Drosophila* endogenous small RNAs bind to Argonaute2 in somatic cells. *Nature* 453: 793-797.

【Term of project】 FY2008-2012	【Budget allocation】 **164,100,000 yen** (direct cost)

【Homepage address】 http://web.sc.itc.keio.ac.jp/dmb/sindex.html

Integrated analysis of transcriptional regulation in cancer

Hiroyuki Aburatani
(The University of Tokyo, Research Center for Advanced Science and Technology, Professor)

【Outline of survey】

In the course of malignant transformation, there accumulate various genetic mutations, structural aberrations and epigenetic changes. To identify those mutations in the cancer genome, systematic analysis of genome, transcriptome and epigenome will be required. I will develop novel applications for such genomic analysis on the high-throughput technologies, e.g. next generation sequencers. Through the integrated analysis of various types of genomic information, I will elucidate the network orchestrated by transcriptional factor complexes involved in cellular proliferation and survival, and the epigenetic regulation in development and differentiation. Furthermore, it will be crucial to integrate 'genetics' and 'genomics', where I will investigate individual differences in transcriptional regulation. Finally, I aim to identify the signaling pathways that drive the cancer cells, which will be potential targets for cancer treatment.

【Expected results】

Through systematic genomic and epigenomic analysis of cancer genome, this research project will provide fundamental information related to carcinogenesis and may identify novel therapeutic targets and biomarkers for cancer. By integrating information on genetic variation, we may develop the prediction system for drug responses, which will enable the personalized medicine by patient stratification.

【References by the principal investigator】

- Redon R, Ishikawa S, et al. Global variation in copy number in the human genome. ***Nature***. 444(7118): 444-454. 2006
- Komura D, et al. Genome-wide detection of human copy number variations using high-density DNA oligonucleotide arrays. ***Genome Res***. 16(12):1575-1584, 2006
- Wendt KS, Yoshida K, et al. Cohesin mediates transcriptional insulation by CCCTC-binding factor. ***Nature***. 451(7180): 796-801. 2008

【Term of project】 FY2008− 2012	【Budget allocation】 **161,400,000 yen** (direct cost)

【Homepage address】 http://www.genome.rcast.u-tokyo.ac.jp/

Dynamic Proteomics of Transcriptional Machinery and Nuclear Architecture

Takao Hamakubo
(The University of Tokyo, Research Center for Advanced Science and Technology, Professor)

【Outline of survey】

After the completion of genome sequencing, analyses of the epigenetic regulation of gene expression and the post-transcriptional processing of mRNAs as well as modifications of proteins have been highlighted for the clarification of living phenomena. To elucidate the interaction of protein complexes in regulatory mechanisms for gene transcription, the development of a method to analyze the dynamic behaviors of multiple protein molecules involved in these reactions has been needed. Identification of functional protein complexes and analysis of spatially-localized variations are important in understanding the regulatory mechanism of gene transcription. Here, we aim at establishing an analytical method for dynamic changes in these protein complexes by: i) investigating the time variation of endogenous protein complexes in transcriptional regulation with targeted proteomics; ii) performing a morphological analysis of nuclear structures using antibody probes under a confocal microscope and an ultrasoft X-ray CT microscope; and, iii) developing an integrated method for analyzing the large amount of data.

【Expected results】

For gene regulation, alterations in chromatin structure and dynamic changes in the machinery for mRNA processing may occur in a coordinated manner. An analytical tool for analyzing these changes will be obtained by producing specific monoclonal antibodies to molecules that would serve as a marker. These antibodies can be used as a tool for structural analysis and genome-wide analysis, as well as proteomics. Establishing a dynamic analytical method for endogenous protein complexes will result in elucidation of important cofactors and epigenetic factors that may play critical roles in the transcriptional regulation of nuclear receptors, and hence may lead to the search of targets for drug discovery, such as cancers and metabolic syndrome.

【References by the principal investigator】

・Horiuchi K, Umetani M, Minami T, Okayama H, Takada S, Yamamoto M, Aburatani H, Reid PC, Housman DE, Hamakubo T, Kodama T. Wilms' tumor 1-associating protein regulates G2/M transition through stabilization of cyclin A2 mRNA. ***Proc Natl Acad Sci U S A***. Nov 14;103(46):17278-83. 2006

・Masuda K, Itoh H, Sakihama T, Akiyama C, Takahashi K, Fukuda R, Yokomizo T, Shimizu T, Kodama T, Hamakubo T. A combinatorial G protein-coupled receptor reconstitution system on budded baculovirus. Evidence for Galpha and Galphao coupling to a human leukotriene B4 receptor. ***J Biol Chem.*** 278(27):24552-62. 2003.

【Term of project】 FY2008－2012	【Budget allocation】 151,600,000 yen (direct cost)

【Homepage address】 http://www.lsbm.org/staff/hamakubo.html/

A Study of Constructing of the Historical Ontology with Digitizing of Historical Materials

Yuzuru HAYASHI

(The University of Tokyo, Historiographical Institute, Professor)

【Outline of survey】

The goals of this study are: 1. To digitize images in films of historical materials collected and stored over the years in the Historiographical Institute of the University of Tokyo, and to define specifications of collected historical materials by digital imaging (Borndigital), and to put the defined specifications into practice on a trial basis, 2. To add meta-data to them and to build a seamless system for processes ranging from storing data in the Archive Hub (digital image storage of historical materials) to making image data available for public use, in order to promote high-grade computerization and sharing of research resources, and 3. To promote research of images and texts based on the digital image materials in the Archive Hub, establishing the historical ontology that integrates time and space information centered on historical figures. To achieve these goals, the workload will be shard between research groups specializing in system development, those specializing in historical knowledge and image material research, and those specializing in text research. First, the order of priority for digitizing materials will be defined on the basis of the magnitude of deterioration of films and the level of urgency thereof, and microfilms in existing collections will be digitized. Next, specifications for collecting materials by digital imaging (Borndigital) will be established and the system will be put into practice on a trial basis, and a server for storing the materials will be constructed. A system required for constructing the Archive Hub for managing materials obtained by research visit will then be developed. After that, meta-data about the collected data (e.g. owner, collected date information, and material group name) and newly prepared catalog data will be added to the data, which will be stored in pre-defined locations on the server. Meanwhile, leading-edge projects will simultaneously be promoted in the fields of images and texts.

Above all, this academic research showcases the evolution of existing organized research and storage systems for Japanese historical materials into the digital phase, and implementation of advanced computerization of research resources existing in the form of collected historical film materials.

【Expected results】

The system will connect text materials, which are retrieved from a search module as historical knowledge, directly with the images related to such historical material, thereby dramatically promoting network-based sharing of resources. Constructing the historical ontology, which means creation of the Historical Wissenschaftslehre (Historical Epistemology), will serve as a frontrunner in the development of Historical Informatics, and will greatly contribute to the maturation and development of the studies of Japanese history.

【References by the principal researcher】

- The Possibilities of Handwriting Analysis: Issues Concerning a System for Searching Kao.
  KAGAKU, Vol76-2, p183～186, 2006.
- An Analysis of Historical Documents Concerninng KumagaiNaozane's Priesthood and Death:
  Case Study on Text Criticism of "Azumakagami".
  Tokyo Daigaku Shiryo Hensan-jo
  KenkyuKiyo,No15,p33～54,2005.

【 Term of project 】 FY2008-2012	【Budget allocation】 151,900,000 yen (direct cost)

【Homepage address】 http://www.hi.u-tokyo.ac.jp

The improvement of the Support system to decode excavated historical documents and the development of the comprehensive research center database.

Akihiro WATANABE

(National Institutes for Cultural Heritage Nara National Research Institute for Cultural Properties, Department of Imperial Palace Sites Investigations, Head of History Section**)**

【Outline of survey】

The objectives of this research are to archive knowledge and information related to "Mokkan"（wooden tablets） and other excavated historical documents, to share the knowledge and information widely, and to provide high performance retrieval methods for the knowledge and information.

Since the condition of the characters is aggravated by their missing parts and aging degradation, archiving and utilizing large amount of the knowledge and information are necessary to read the characters written on the mokkans. Therefore, by expanding our current research results ("Mokkanshop": the support system to decode mokkans/"Mokkanjiten": the database of the knowledge and information related to the mokkans), we conduct a new research to build the following items:

(1) A new support system to decode mokkans that contains high high performance recognition/retrieval functions of the character patterns and communication functions for ubiquitous network among archaeologists and their knowledge (hereafter called "new Mokkanshop").

(2) A comprehensive research center database that expands the knowledge and information beyond the time and place distances, standardizes the format to record the knowledge and information, and provides the links with GIS and historical document databases (hereafter called "new Mokkanjiten").

Additionally, by interlocking new Mokkanshop and new Mokkanjiten, and by shareing the knowledge and information, this research starts and sustains the chain reaction between "decoding mokkans by using the archived information and knowledge" and "archiving the information and knowledge by decoding mokkans".

【Expected results】

The "Comprehensive Research Center (CRC)" consisting of the new Mokkanshop and new Mokkanjiten becomes a breakthrough in the research areas of the excavated historical documents and history (especially, in the ancient time of Japan). Additionally, the CRC accelerates the researches of historical potteries and lacquered paper documents, works with other historical research institutes and databases. Moreover, the CRC can be utilized for the researches of historical Kanji documents in China, Korea, and other East Asian country, and for the researches of historical characters in the world. Finally, the CRC becomes an unprecedented research result of the historical research in the world.

【References by the principal investigator】

・Akihiro WATANABE: The Century of Heijo and Mokkan, *Japanese History 04*, Kodansha Ltd., 2001.

・Akihito KITADAI, Masaki NAKAGAWA, Hajime BABA, Akihiro WATANABE et al.: Context Processing to Support Decoding Mokkans, *Japan Society for Archaeological Information*, Vol.13, p.p.22-33, 2007.

【Term of project】 FY2008－2012	【Budget allocation】 **104,000,000 yen** (direct cost)

【Homepage address】 http://hiroba.nabunken.go.jp/

Frontiers of Game Theory: Theory and Applications

Akira Okada
(Hitotsubashi University, Department of Economics, professor)

【Outline of survey】

The globalization of the modern society makes the interdependence of economic agents, at all levels of individuals, organizations, regions, and nations, ever more complicated. While there are more opportunities for cooperation, there are (probably even more) instances where the conflict of interest is so predominant to limit the efficacy of the market mechanism. Examples include the progression of global warming and the fragility of international financial markets. More generally, these problems tend to arise from such factors as uncertainty, externality, incomplete markets, imperfect information, and strategic interactions. Game theory is a fundamental tool to analyze these factors.

In this research, we ask how to attain efficient and fair social states through designing markets and institutions. For this purpose, we partition the research topics at the frontier of game theory into three groups, (1) dynamics and incomplete information of the market mechanism, (2) information and incentive in organizations, and (3) political economy; and assess the impact of interdependence across markets and institutions from a broad perspective involving cognition, emotion, rationality, information, evolution, and convention.

【Expected results】

The success of the project promotes the research of game theory in Japan, and enhances our academic status as a research center of game theory in the international community. The project makes it possible for us to construct an international research network. In the field of economics, our research of game theory complements the traditional approach of the general equilibrium theory, and improves the applicability of economic analysis to the factors, such as uncertainty, incomplete markets, externality, organizations and political economy, which may cause market failure.

【References by the principal investigator】

- Akira Okada, *Game Theory*, Yuhikaku Publishing Co., Ltd., 1996.
- Akira Okada, "A Noncooperative Coalitional Bargaining Game with Random Proposers," *Games and Economic Behavior* 16 (1), 1996, 97-108.

【Term of project】 FY2008－2012	【Budget allocation】 **139,600,000 yen** (direct cost)

【Homepage address】 http://wakame.econ.hit-u.ac.jp/~aokada/

Joint Research on Innovation Processes among Industry, Universities and Government

Hiroyuki Chuma
(Hitotsubashi University, Institute of Innovation Research, Professor)

【Outline of survey】

This research project tries to understand, from theoretical and empirical perspectives, the main characteristics of innovation processes in Japan and pursue for the scheme for overcoming the weakness. In particular, the special attention is paid to science-based industries such as semiconductor, biotechnology, and pharmaceuticals. This research is conducted as the joint research among industry, universities and government. Specifically, New Energy and Industrial Technology Development Organization (NEDO), National Institute of Science and Technology Policy (NISTEP), Semiconductor Technology Roadmap Committee of Japan (STRJ), Japan Bioindustry Association (JBA), Japan Pharmaceutical Manufacturers Association (JPMA), and Office of Pharmaceutical Industry Research (OPIR) actively participate in this joint research project

【Expected results】

This project is quite unique in that it is conducted as the collaborative research among social & natural scientists and engineers in industry, universities and government. Hence it is expected to produce lots of original and rich academic research results that could fully satisfy international standards. Moreover, The results of this research project could provide many important implications for revitalizing Japanese National Innovation System that has started to lose its competitiveness. Interim and final results will be sequentially published in research papers or books and presented in international conferences.

【References by the principal researcher】

・”Moore's Law, Increasing Complexity, and the Limits of Organization: The Modern Significance of Japanese Chipmakers' DRAM Business,”(with N. Hashimoto), RIETI Discussion Paper, 08-E-001, 2008
・Chuma, Hiroyuki, "Determinants of the Shadow Value of Simultaneous Information Sharing in the Japanese Machine-tool Manufacturing Industry," Ogura, Seiritsu, Toshiaki Tachibanaki, and David A. Wise, eds., Labor Markets and Firm Benefits Policies in Japan and the United States, (National Bureau of Economic Research Report), University of Chicago Press, 2003, pp. 81-102
・"Increasing Complexity and Limits of Organization in the Microlithography Industry: Implications for Science-based Industries," Research Policy, Vol. 35, No. 3, April 2006, pp. 394-411

【Term of project】 FY2008－2012	【Budget allocation】 **109,200,000 yen** (direct cost)

【Homepage address】 http://www.iir.hit-u.ac.jp/

Spill-Over and Cycle Effects of Regional Integration: Growth and Cycles of Asia and Enlarged EU

Akira Kohsaka

(Osaka University, School of International Public Policy, Professor)

【Outline of survey】

Under the WTO-IMF regime the globalization of the world economy has increased international mobility of goods, services and capital flows. In addition regional integration has enhanced regional linkages where the expansion and deepening of *production networks* based on international division of labor has promoted regional economic growth (*spill-over effects*). Empirical research on these points is not well-developed yet, though.

Whether or not the enhanced linkage of capital markets has promoted economic growth has not been ensured by empirical research yet. Rather, it appears likely that enhanced capital movements increase financial risks so as to generate financial crises. The impact of integration upon business cycles, thus, tends to magnify the cycles through suppressing financial risks (*cycle effects*).

This study examines the spill-over effects of regional integration through production-networking in the Asia-Pacific region, the cycle effects through increasing and deepening assets markets as well as asset accumulation, and then the interactions between the two effects. Then this study scrutinizes some policy options and designs development strategies to cope with these changing industrial structures and financial markets.

【Expected results】

The engine of regional integration through trade and investment in the Asia-Pacific region is multi-national corporations rather than trade and investment agreements, while the enlarged EU aims at reforming industrial structures through active investment policies as its globalization strategy. This study will show how the regional integration shapes industrial structures and clarify the impacts of the spill-over effects on regional economic growth and business cycles. Meanwhile the enlarged EU tries to consolidate their macroeconomic policies by way of a common currency, whose experiences will give some important lessons to the Asia-Pacific region despite different initial and other conditions between the two regions. This study will highlight the complementary relation between financial intermediation and capital markets to live with cycle effects and design some regional currency regimes for stabilization and external adjustments in the region.

【References by the principal investigator】

- Kohsaka, Akira, “A Fundamental Scope for Regional Financial Cooperation in East Asia,” Yoshinori Shimizu, ed., ***Economic Dynamism of Asia in the New Millenium: From the Asian Crisis to a New Stage of Growth***, World Scientific Publishing, Singapore, 2007, pp. 139-176.
- Kohsaka, Akira and Masahiro Enya, “The Balance Sheet Effects and Macroeconomic Development in the Pacific Region,” ***Asian Economic Papers***, vol. 6, issue 1, 2007, pp. 101-129.

【Term of project】 FY2008－2011	【Budget allocation】 68,200,000 yen (direct cost)

【Homepage address】 http://www2.osipp.osaka-u.ac.jp/~kohsaka

A Comprehensive Study Examining the Forms of Social Stratification in an Aging Society and Constructing Public Norms

Sawako Shirahase
(The University of Tokyo, Department of Sociology, Associate Professor)

【Outline of survey】

There are two main objectives in this study. The first is to examine the forms and the generating mechanism of social stratification in an aging society. The second is to construct the theoretical concept of public norm, as the backbone of our aging society that maintains a high level of sustainability and of equity. We plan to conduct a large-scaled nationally-representative survey primarily targeted at the elderly in 2010. In this survey, we will interview not only respondents but also their co-resident members in the household, and the questionnaire for the family members living separately will be included. Case studies of the families facing economic difficulties such as lone-parents and single-person households will also be conducted. Based on such empirical analyses of various types of survey data, we will develop stratification theory that can explain socio-economic inequality in an ageing society.

【Expected results】

The previous stratification theory was primarily built on people's social positions determined by the relationship to the labor market, and those who are either temporarily or permanently out (such as by retirement) of the labor market were left out. In contrast, our study will develop social stratification theory for the new era with ageing population to explore the mechanism through which the socio-economic resources are allocated in a rapidly aging society.

【References by the principal researcher】

- *The Unseen Gaps in an Aging Society: Locating Gender, Generation, and Class in Japan* (2005, University of Tokyo Press)
- *Inequality in a Changing Society: Hidden Disparities behind the Demographic Shift in Japan* (ed.) (2006, University of Tokyo Press)

【Term of project】 FY2008－2012	【Budget allocation】 **129,400,000 yen** (direct cost)

【Homepage address】 under construction

Development of computer assisted analysis for complicated nonlinear phenomena

Mitsuhiro T. Nakao
(Kyushu University, Faculty of Mathematics, Professor)

【Outline of survey】

Computer assisted proof or numerical verification method are mathematically rigorous techniques for the existence of solutions for mathematical problems by numerical computations on computer. These techniques are now, in corporation with exciting development of recent computers, growing up to be important methodology for analyzing complicated nonlinear problems in mathematical analysis and computational science and technology, for which existing theoretical approaches seem to be difficult to apply. The principal researcher has been working on such a verification method for years, particularly for nonlinear elliptic equations, and he obtained various kinds of pioneering results in this field up to now. The present research aims, based on the existent products for stationary problems, at further development of new verification techniques, including evolutional equations. As a final goal, it is expected to establish the computer assisted proof as an important methodology of mathematical analysis in this century.

【Expected results】

Various kinds of open problems for partial differential equations or dynamical systems related to complicated nonlinear phenomena, such as Navier-Stokes equation, Chaos etc., could be proved by computer assisted approaches. Also, in other science and technology, a new and great contributions by mathematics are expected in the reliability of numerical simulations through the mathematically rigorous estimates of error for approximation schemes, e.g., the finite element method and so on.

【References by the principal researcher】

・M.T.Nakao, K.Hashimoto, Y.Watanabe, A numerical method to verify the invertibility of linear elliptic operators with applications to nonlinear problems, Computing 75 (2005), 1-14.
・Y.Watanabe, N.Yamamoto, M.T.Nakao, T.Nishida, A numerical verification of nontrivial solutions for the heat convection problem, Journal of Mathematical Fluid Mechanics 6 (2004), 1-20.

【Term of project】 FY2008－2011	【Budget allocation】 65,300,000 yen (direct cost)

【Homepage address】 http://www2.math.kyushu-u.ac.jp/~mtnakao/

Theory of global well-posedness on the nonlinear partial differential equations

Hideo Kozono

(Tohoku University, Graduate School of Science, Professor)

【Outline of survey】

We deal with the nonlinear partial differential equations arising from the mathematical physics and biology. In particular, we are interested in the equations which govern the fluid motion. Our goal is to establish a unified theory on well-posedness of the equation such as existence, uniqueness and stability of solution. Concerning the stationary problem, we first investigate the one in the whole space, and then interior and exterior boundary value problems will be discussed In the interior problem, we bring a focus into the effect of topological type of the domain such as numbers genus onto solvability of the equations. In the exterior problems, the behavior of solutions in the suitable norm with the anisotropic weights is closely related to the shape of the obstacle, and the asymptotic decay property at the space infinity will be discussed intensively. As for the non-stationary problem, we make it clear smallness of the given data in the class of scaling invariant norms which guarantee global existence of classical solutions. As a conclusion, we will construct a unified theory on global well-posedness on nonlinear PDE. Here it should be emphasized that global solvability of classical solutions for large initial data to the 3D Navier-Stokes equations are proposed as one of the seven Millennium problems by the Clay institute with each one million dollars' prize. This is one of the themes in this research project.

【Expected results】

By charactering various boundary conditions on the harmonic vector fields, we first establish the Helmholtz-Weyl decomposition in L^p-spaces, and then deal with the steady problem for the Navier-Stokes equations under the inhomogeneous boundary data. It is expected that the relation between solvability of the equation and he flux condition on the boundary data will be clarified. Based on the end-point Strichartz's estimate, the L^p-L^q-estimates for the linealized evolution operators have been so fully developed in recent years that we might make further progress in the local and global well-posedness on the nonlinear dispersive and wave equations.

【References by the principal investigator】

・Kozono,H, Navier-Stokes equations, Sugaku 54 (2002), 178--202.

・Kozono,H, Ogawa,T., Misawa,M., Perspective in Nonlinear PDE Nippon-Hyoronsha 2007.

【Term of project】 FY2008－2012	【Budget allocation】 136,800,000 yen (direct cost)

【Homepage address】 http://www.math.tohoku.ac.jp/researchfields/kozono.html

Probing the Dark Age: From First Generation Objects to Primordial Galaxies

Masayuki Umemura

(University of Tsukuba, Graduate School of Pure and Applied Sciences, Professor**)**

【Outline of survey】

The objective is to probe the dark age in the universe, using a Cosmo-Simulator "FIRST" that has been developed by Specially Promoted Research in Grants-in-Aid for Scientific Research (2004-2007). We explore the physical processes of the formation of first generation objects in dark matter and the subsequent formation of primordial galaxies, by performing large-scale simulations, where self-gravity, hydrodynamics, radiation transfer, and non-equilibrium chemistry of primordial gas are consistently incorporated in the system composed of dark matter, baryonic gas, and stars. In particular, we scrutinize the first star formation induced by the collapse of cold dark matter density fluctuations, the metal enrichment of intergalactic medium by supernova explosions in first generation objects, the reionization history through the formation of luminous sources, the galaxy formation in a reionized universe, the formation of globular clusters in ultraviolet radiation, and the evolution of primordial galaxies via supernova explosions.

【Expected results】

We aim at establishing the physical picture of the dark age in the universe, by performing integrative cosmological simulations on the star formation history in first generation objects and the galaxy formation in a reionized universe. This research brings us understanding of the missing history of galaxy formation, and also elucidation of the physical state of Lyman alpha emitters with redshifts higher than 6, and the contribution of first generation objects and primordial galaxies to the metal enrichment of intergalactic medium. Furthermore, the event rate of gamma ray bursts at high redshifts, and the origin of globular clusters are illuminated.

【References by the principal investigator】

- M. Umemura, H. Susa, T. Suwa, D. Sato, and FIRST Project Team, FIRST Project: Formation and Feedback of First Stars, *First Stars III*, 386-389 (2008)
- H. Susa and M. Umemura, Secondary Star Formation in a Population III Object, *Astrophysical Journal Letters*, **645**, L93-L96 (2006)
- M. Mori and M. Umemura, The Evolution of Galaxies from Primeval Irregulars to Present-day Ellipticals, *Nature*, **440**, 644-647 (2006)

【Term of project】 FY2008－2012	**【Budget allocation】** **73,100,000 yen** (direct cost)

【Homepage address】 Under construction

Digital Accelerator based on the Induction Acceleration Method

Ken Takayama
(High Energy Accelerator Research Organization, Accelerator Laboratory, Professor)

【Outline of survey】

The digital accelerator is based on the induction synchrotron concept, which had been demonstrated at KEK in 2006. All ions including cluster ions and RI ions in the digital accelerator are accelerated and captured with pulse voltages generated by transformers (induction acceleration cell). The transformer is energized by the corresponding switching power supply, in which power solid-state conductors are employed as switching elements and their tuning on/off is maneuvered by gate signals digitally manipulated from the circulating signal of an ion beam. This digital accelerator will be realized by modifying the existing KEK 500 MeV Booster. Actually the RF cavities will be replaced by the induction cells. An operation frequency of the main magnet system will be changed from 20 Hz to 10 Hz to reduce a required maximum acceleration voltage. In addition, a vacuum of the beam pipe will be improved so as to accommodate heavy ions, which are injected from a 200 kV ion source. At the end of survey, various ion beams will be ready to be delivered to applications of nano science, warm dense matter science, and mutation.

【Expected results】

- The third type of circular accelerator beyond the cyclotron and conventional synchrotron will be demonstrated.
- Heavy ions, such as Ar, will be accelerated from a quite low energy to high energy by the digital accelerator without an injector, such as an RFQ or linac c.
- The demonstrated digital accelerator will become a typical ion driver for a particle cancer therapy, where a cost performance is strongly required for the spread of this therapy.

【References by the principal researcher】

- K.Takayama, Y.Arakida, T.Iwashita, Y.Shimosaki, T.Dixit, K.Torikai, “All-ion accelerators: An injector-free synchrotron, *J. of Appl. Phys.* **101**, p063304-7 (2007).
- K,Takayama, K.Torikai, Y.Shimosaki, Y.Arakida, E.Nakamura,H.Sato *et al.*, “Experimental Demonstration of the Induction Synchrotron”, *Phys. Rev. Lett.* **98**, p054801 (2007).
- K.Takayama et al. ”Observation of the Acceleration of a Single Bunch by Using the Induction Device in the KEK Proton Synchrotron”、*Phys. Rev. Lett.* **94**, p144801 (2005).
- K.Takayama and J.Kishiro, ”Induction Synchrotron”, *Nucl. Inst. of Meth*, **A451**, p304 (2000).

【Term of project】 FY2008− 2010	【Budget allocation】 **166,700,000 yen** (direct cost)

【Homepage address】 http://www-accps.kek.jp/Superbunch/

Study of Jets in Quark Gluon Plasma with Parton Identification

Yasuo MIAKE

(University of Tsukuba, Graduate School of Pure and Applied Sciences, Professor)

【Outline of survey】

At a few microseconds after the birth of the Universe or deep inside a super dense star, it is expected that there is another state of the matter where quarks and gluons are not confined to hadrons, i.e. Quark-Gluon Plasma (QGP). The study of this new state is deeply connected to a basic question of the natural science, and because of that, it is one of the major topics of the physics today.Experimental study to create and investigate the property of the QGP has being carried out at Brookhaven National Laboratory and also at CERN. Relativistic Heavy Ion Collider(RHIC) has been operated since 2000, and a lot of interesting features have been found; namely, early thermalization, hydro-dynamical behavior and characteristic hadronization mechanism. All these features support the formation of QGP in the RHIC collision.

For the study of property of the QGP, it is believed that the measurement of jets is one of the most powerful tools. For example, if one measures the angle of Mach cone, the sound velocity in the gluon field can be determined. From the measurement of the characteristic energy loss of partons in the QGP, the information of the gluon density can be obtained.

Having the new era opened by the LHC accelerator, it is very important to carry out systematic measurements and comparisons of RHIC and LHC data.

In particular, the study of jet behavior would be one of the key issues in this field.

【Expected results】

- A new device suitable for jet triggering and identification will be developed and constructed.
- Carry out studies of jet both at RHIC-PHENIX and LHC-ALICE experiments for the systematic comparison.
- Challenge the identification of primary parton fragmenting to jets of particles, which is very difficult in the heavy ion collision because of backgrounds due to the anisotropy and the high multiplicity. Identification of the primary parton would provide crucial information.

【References by the principal investigator】

- Quark-Gluon Plasma. K. Yagi, T. Hatsuda and Yasuo MIAKE, Cambridge Monographs on Particle Physics, Nuclear Physics and Cosmology, Cambridge University Press, 2005
- Formation of dense partonic matter in relativistic nucleus-nucleus collisions at RHIC: Experimental e valuation by the PHENIX collaboration. K. Adcox, T. Chujo, S.Esumi, Y. Miake et al., Nucl.Phys.A 757:184-283,2005.

【Term of project】 FY2008− 2012	【Budget allocation】 **65,400,000 yen** (direct cost)

【Homepage address】 http://utkhii.px.tsukuba.ac.jp/

Many body quantum phenomena in electron-hole ensembles

Makoto Gonokami
(The University of Tokyo, School of Engineering, professor)

【Outline of survey】

Electrons and holes in semiconductors undergo strong Coulomb attraction, forming ensembles in various phases such as exciton gas, electron-hole plasma, electron-hole liquids and exciton condensates. In this project, we perform a systematic and quantitative survey of such phases by a combination of laser spectroscopic experiments and theoretical calculations focusing on the following topics: 1. Search for the phase diagram of electron-hole ensembles including the condition for Bose-Einstein condensation of excitons. 2. Observation of collective excitation of quantum degenerate electron-hole ensembles and their coherence. 3. Theoretical modeling of the dynamics of quantum phase transition of electron-hole ensembles.

【Expected results】

A deeper understanding of carrier correlation effects is an important issue from both fundamental and application points of views. In conventional semiconductor optoelectronic devices such as semiconductor lasers, carrier correlation effects are well reproduced by a mean field approximation. In nanoscale quantum devices, however, we cannot apply the mean field theory. The search for Bose Einstein condensation of excitons has long been a pending question in semiconductor optics. The lack of quantitative information on exciton-exciton interactions, i.e. carrier correlation effects, prevented a systematic understanding of the experimental results. We are planning to reformulate these problems based on a systematic investigation of carrier interactions which will be explored in this project by an experimental and theoretical collaborative study. This may bring us an opportunity to develop new functional devices.

【References by the principal investigator】

・M. Kuwata-Gonokami, M. Kubouchi, R. Shimano, A. Mysyrowicz, "Time-resolved Excitonic Lyman Spectroscopy of Cu_2O", J. Phys. Soc. Jpn. **73** (4), 1065-1069 (2004).
・M. Kuwata-Gonokami, “Dynamics of cold excitons and electron-hole ensembles in direct-gap semiconductors studied by mid-infrared pump and probe spectroscopy”, in *“Problems of Condensed Matter Physics”* Edited by Alexei L. Ivanov and Sergei G. Tikhodeev, Oxford Univ Press, P135-162.

【Term of project】 FY2008－2012	【Budget allocation】 115,300,000 yen (direct cost)

【Homepage address】 http://www.gono.t.u-tokyo.ac.jp

Small-area two-dimensional photoelectron spectroscopy

Hiroshi Daimon
(Nara Institute of Science and Technology, Graduate School of Materials Science, Professor)

【Outline of survey】

The demand for small-area analysis became important due to the down-sizing of devices used in, i.e., multi-functional mobile phone. The "two-dimensional photoelectron spectroscopy" developed by ourselves is a powerful analysis method, which can analyze three-dimensional band structure and atomic configuration. However it has been impossible to analyze small sample because the diameter of incident light beam is thicker than 1 mm. The acceptance angle of usual analyzer so far is limited to small angular range when the kinetic energy of the electron is high. In this project we complete the Stereo-PEEM (Stereo photoelectron emission microscope) and DELMA (Display-type Ellipsoidal Mesh-lens Analyzer), which were invented in JST-CREST project for five-years. They enable us to view the magnified image of the sample surface as well as the angular distribution of electrons. A laboratory x-ray source will also be constructed.

【Expected results】

Two-dimensional photoelectron spectroscopy for only one small crystal will become possible for the first time especially for high kinetic energies. The development of higher performance devices, i.g., Si solar cell, or Fe-RAM devices will be accelerated by the two-dimensional photoelectron spectroscopy analysis of only one particle. Because the low-dimensional and quantum mechanical effect, which are characteristic to small materials, can be revealed and contribute to science.

【References by the principal investigator】

・Stereo-PEEM for three-dimensional atomic and electronic structures of microsc opic materials, H. Daimon, H. Matsuda, L. Toth, F. Matsui, Surface Science , 601(20) 4748-4758, (2007).
・Stereo Photography of atomic arrangement and atomic-orbital analysis by two-dimensional photoelectron spectroscopy, F. Matsui, T. Matsushita, F. Z. Guo , H. Daimon, Surf. Rev. Lett. 14(3) 1-7, (2007).

【Term of project】 FY2008－2012	【Budget allocation】 132,200,000 yen (direct cost)

【Homepage address】 http://mswebs.naist.jp/LABs/daimon/index-j.html

Exotic Superconducting State of Heavy Fermion Compounds

Yuji Matsuda
(Kyoto University, Graduate School of Science, Professor)

【Outline of survey】

In rare earth or actinoid intermetallic compounds, the effective mass of the electrons can be strongly enhanced due to the hybridization between the *f*-electrons and conduction *d*- or *s*- electrons; the so-called "heavy-fermion" state is realized. The heavy fermion compounds often show a superconductivity and their superconducting state exhibits a rich variety of unusual properties. Although the study of the heavy fermion superconductors has started nearly 30 years ago, the research is facing a new phase, because many of them were discovered after it had become the 21st century. Heavy fermion superconductivity is one of the most basic problems in physics, because it is closely related to the Bose-Einstein condensate of atomic gases and high energy physics. Therefore its clarification becomes a key to the understanding of the novel condensed states of the material. In this research, heavy fermion artificial superlattice are fabricated to clarify the exotic superconducting state of these systems. In addition, new experiment technique are developed to probe the exotic superconducting states.

【Expected results】

By fabricating the artificial superlattice whose basic unit is heavy fermion compounds, we are able to create novel electronic systems, particularly systems which show unprecedented superconducting properties, including spatially non-uniform superconducting state and superconducting state without inversion symmetry. We will investigate these systems systematically by the electron transport, magnetic, optical reflection, nuclear magnetic resonance measurements. These studies enable us to make understanding of the novel superconducting state of the heavy fermion compounds advance greatly.

【References by the principal investigator】

・Angular Position of Nodes in the Superconducting Gap of Quasi-2D Heavy-Fermion Superconductor $CeCoIn_5$, K. Izawa, H. Yamaguchi, Yuji Matsuda, H Shishido, R. Settai, and Y. Onuki, Phys. Rev. Lett. 87, 057002 (2001)

【Term of project】 FY2008－2012	【Budget allocation】 165,200,000 yen (direct cost)

【Homepage address】 http://kotai2.scphys.kyoto-u.ac.jp/index.php

Investigation of novel quantum states in actinide-based compounds with unstable valence

Noriaki SATO
(Nagoya University, Graduate School of Science, Professor)

【Outline of survey】

Magnetism and superconductivity have both received much interest in the field of condensed matter physics. An actinide-based material is believed to show intermediate nature between itinerant-3*d* and localized-4*f* element based materials. However, its true nature is yet to be clarified. This is because the radio activity of the actinide element makes experiments difficult to perform. Nevertheless, a challenging effort has revealed that there are novel actinide-based compounds, that is, (anti)ferromagnets exhibiting the coexistence with superconductivity. Understanding of the interplay between magnetism and superconductivity is an attractive challenge for solid state physicists. Recognizing this situation, this project aims to explore the electronic states of the actinide-based compounds with unstable valence. For that purpose, we establish a station for the single crystal growth that is authorized to handle actinide materials. Further we plan to develop a redox flow battery.

【Expected results】

By establishing an actinide investigation center to prepare a good-quality single crystal of actinide compounds and provide them to a researcher of the field, the actinide research in Japan is expected to keep active. It is also expected that the resolving of problems characteristic of the actinide materials, including the interplay between ferromagnetism and superconductivity, makes substantial influence on other fields of the solid state physics. It is further expected that the development of a redox flow battery will open up a new road to the reuse of actinide materials.

【References by the principal investigator】

・Stoner gap in the superconducting ferromagnet UGe_2,
N. Aso, N. K. Sato *et al.*, Phys. Rev., B**73** (2006) 054512-1-5.
・Strong coupling between local moments and superconducting ‘heavy’ electrons in UPd_2Al_3,
N.K. Sato, F. Steglich, P. Fulde *et al.*, Nature, **410** (2001) 340-343.

【Term of project】 FY2008－2012	【Budget allocation】 **149,900,000 yen** (direct cost)

【Homepage address】 http://mlbp.phys.nagoya-u.ac.jp/

Rheology of the high-pressure mantle minerals using giant single crystals and technology of high-pressure generation in large volumes

Tomoo KATSURA

(Okayama University, Institute for Study of the Earth's Interior, professor)

【Outline of survey】

Although the Earth's mantle mainly consists of solid minerals, it dynamically flows in geological time scales. The flow of the mantle materials, so called mantle convection, causes various kinds of geophysical phenomena observed on the surface. Therefore, quantitative understanding of mantle convection is one of the most important issues in solid-Earth geophysics. At present, however, we are not able to understand mantle convection quatitatively. One of the reasons is that we do not have sufficient knowledge on rheology of high-pressure mantle minerals because the sufficiently large size of single crystals of high-pressure mantle minerals were available. Fortunately, it is now possible to synthesize single crystals of high-pressure mantle minerals sufficiently large for rheological study. By using such giant single crystals and technology of pressure generation in large volumes, we will conduct the following experiments for high-pressure mantle minerals such as wadsleyite, ringwoodite majorite perovskite, and stishovite.

1) Measurement of silicon self-diffusion coefficient as a function of P and T.
2) Observation of dislocation creep mechanism as a function of P, T and $\dot{\varepsilon}$.
3) Measurement of mobility of dislocation as a function of P and T.
4) Determination of equilibrium grain size as function of P, T and $\dot{\varepsilon}$ by dynamic recrystallization experiment.

【Expected results】

Dislocation and diffusion creeps are two major mechanisms for deformation of minerals. The diffusion creep rate can be estimated from silicon self-diffusion coefficient and grain size. The P-T dependence of dislocation creep rate can be estimated from dislocation mobility and silicon self-diffusion coefficient. Such information will make it possible to quantitatively understand dynamics of the mantle. For example, we can examine the hypothesis that the stagnation of subducted slab above the 660-km discontinuity is because of the viscosity contrast between the upper and lower mantles.

【References by the principal investigator】

- Shatskiy A., Fukui H., Matsuzaki T., Shinoda K., Yoneda A., Yamazaki D., Ito E. & Katsura T., Growth of large (1 mm) $MgSiO_3$ perovskite single crystals: A thermal gradient method at ultrahigh pressure, *American Mineralogists* **92**, 1744-1749, 2007.
- Yamazaki, D., Kato, T., Yurimoto, H., Ohtani, E., Toriumi, M., Silicon self-diffusion in $MgSiO_3$ perovskite at 25 GPa, *Physics of the Earth and Planetary Interiors* **119**, 299-309, 2000.

【Term of project】 FY2008－2012

【Budget allocation】
175,100,000 yen (direct cost)

【Homepage address】 http://www.misasa.okayama-u.ac.jp/~hacto/

Research on active tectonics in central Japan based on integrated seismic experiments with long shot- and receiver-offsets

Tanio Ito

(Chiba University, Graduate School of Science, Professor)

【Outline of survey】

It is traditionally believed that active tectonics in central Japan has been controlled by the convergent movement between the North American and the Eurasian plates along the Itoigawa-Shizuoka Tectonic Line (ISTL). However recent accumulation of both geological and geophysical data requires us to reexamine the traditional idea and to establish the new one that the tectonics may be strongly related with the subducting Philippine Sea (PHS) Plate. In order to do so, we conduct 3 integrated seismic transects with long shot- and receiver-offsets in this survey: Across-central Japan, Southern margin of central Japan, and Across-Tsurugawan-Isewan Tectonic Line (TITL).

【Expected results】

1. Basic data sets for the research of active tectonics, such as configuration of PHS plate, relationship between the crustal structure and active faults, seismic velocities and their heterogeneities in the crust, are expected to be obtained and provided to academic communities.
2. New model on strain loading system in central Japan is expected to be proposed against two types of the well-established models: the loading system associated convergent plate boundary and that due to the structural inversion. This new model will be significant for the improvement of earthquake prediction studies.

【References by the principal investigator】

・Crustal structure of southwest Japan, revealed by the integrated seismic experiment Southwest Japan 2002 (Ito et al., 2008, in press)
・Active nappe with a high slip rate: seismic and gravity profiling across the southern part of the Itoigawa-Shizuoka Tectonic Line, central Japan (Ikeda, Ito, and others, 2008, in press)
・Gently N-dipping Median Tectonic Line(MTL) revealed by recent seismic reflection studies, southwest Japan (Ito et al., 1996, Tectonophysics, **264**, 51-63)

【Term of project】 FY2008－2010	【Budget allocation】 **147,600,000 yen** (direct cost)

【Homepage address】 http://www-es.s.chiba-u.ac.jp/struct/site/struct.html

Study on Mass Extinction: The P-T boundary and V-C boundary events

Yukio Isozaki

(The University of Tokyo, Graduate School of Arts and Sciences, Professor)

【Outline of survey】

Major mass extinctions occurred 5 times in the Phanerozoic (last 550 million yeas), although their causes and relevant environmental changes were not well explained yet. This project aims to clarify the cause and practical processes of the two big mass extinction events; i.e. the P-T boundary (ca. 250 m.y. ago) and V-C boundary (ca. 550 m.y. ago) events. The project comprises 1) intensive fieldstudy including drilling for unaltered rock samples, and 2) detailed geochemical analyses in laboratory by using SEM-EDS, XRF, and XRD, plus measurements of paleomagnetism and radiometric dating. Main targets include the P-T boundary rocks in central Europe, Mid-East, South China, and V-C boundary rocks in South China and Mid-East. Collected samples will be analyzed mostly in Japan for major and trace element compositions, isotope ratios of C, O, S, and Sr, paleo-magnetic polarity, and radiometric ages.

【Expected results】

This project will document information of Permo-Triaasic sweater of shallow-sea around the supercontinent and mid-oceanic shallow- and deep-sea of the superocean for the first time. Various geochemical analyses will prove whether or not the Kamura cooing event first found in Japan was really a global phenomenon, and confirm the processes ofonset and retreat of the superanoxia across the P-T boundary. Further analysis on volcanic tuff around the boundary will indicate an intimate relationship between mantle plume activity and the turmoil on the Earth's surface. These will lead the project in the later stage that aims to clarify the cause and processes of much older V-C boundary event.

【References by the principal investigator】

Isozaki, Y., 1997. Permo-Triassic boundary Superanoxia and stratified superocean: Records from lost deep-sea. *Science*, **276**, 235-238.

Isozaki, Y., 2007. Plume Winter scenario for biosphere catastrophe: the Permo-Triassic boundary case. In Yuen, D., Maruyama, S., Karato, S. and Windley, B.F. (eds.), Superplumes: beyond plate tectonics. pp. 409-440, Springer, Dordrecht.

【Term of project】 FY2008− 2012	【Budget allocation】 **102,900,000 yen** (direct cost)

【Homepage address】 http://ea.c.u-tokyo.ac.jp/earth/Members/isozaki.htm

Visualization of electron transfer in matter with a time-resolved reaction microscope for electron Compton scattering

Masahiko Takahashi

(Tohoku University, Institute of Multidisciplinary Research for Advanced Materials, Professor)

【Outline of survey】

The purpose of this project is to develop a time-resolved reaction microscope for electron Compton scattering by gaseous molecules. It is a method to visualize the change of electron motion in a transient species, which is the driving force behind any chemical reaction, or to see in momentum space how the electron wave function would evolve as time advances. Here the inelastically scattered electron, ejected electron, and fragment ion produced by Compton scattering in the collision of a pulsed electron beam with the transient species, that is prepared beforehand with a pump pulse laser, are measured in coincidence, whilst the timing of the ionization with respect to the pump pulse is varied. The experimental data of vector correlations amongst the three charged particles are subsequently employed to construct the electron momentum distribution functions of the transient species as a function of electron binding energy in addition to the timing of the ionization. This method represents the first time that the change of electron motion in matter would become observable, thus developing previously uncharted areas of photoinduced ultrafast dynamics such as excitation-energy transfer, electron transfer and isomerisation processes. Furthermore, the method can be recognized as the first pump-and-probe approach combining electron impact ionization with the ultrafast dynamics.

【Expected results】

The time-resolved reaction microscope for electron Compton scattering can be realized by combining the latest pulsed laser techniques with the kinematically-complete electron Compton scattering experiment in the molecular frame that our group has recently pioneered. By keeping in mind that, at present, only theory has access to the electron wave function itself, the outcome of this project is expected to have a profound impact upon a wide range of fields from material science to life science. For instance, qualitative changes could be brought about eventually into the understanding of chemical bonding and chemical reactions.

【References by the principal investigator】

・M. Takahashi, N. Watanabe, Y. Khajuria, Y. Udagawa, and J. H. D. Eland, "Observation of a Molecular Frame (*e*, 2*e*) Cross Section: An (*e*, 2*e*+*M*) Triple Coincidence Study on H_2", *Phys. Rev. Lett.* **94**, 213202 (2005).
・M. Takahashi, "Development of Molecular Frame (*e*, 2*e*) Spectroscopy by Means of a Triple Coincidence Technique" (in Japanese), *BUTSURI*, **61**, 90 (2006).

【Term of project】 FY2008－2012	【Budget allocation】 **118,400,000 yen** (direct cost)

【Homepage address】 http://www.tagen.tohoku.ac.jp/labo/takahashi/index.html

The Origins of Chirality and Amplification in Asymmetric Autocatalysis

Kenso Soai

(Tokyo University of Science, Faculty of Sciences, Professor)

【Outline of survey】

Biomolecules such as L-amino acids are known to exist as one of the enantiomers. The origins of chirality and amplification have attracted much attention (“What Remains to be Discovered,” J. Maddox, Newton Press, 2000). They are also related to the origin of life. Soai (principal researcher) and co-workers discovered asymmetric autocatalysis of pyrimidyl alkanol with significant amplification of chirality in the enantioselective addition of diisopropylzinc to pyrimidine-5-carbaldehyde. This unique reaction is the automultiplication of chiral compounds. The present research focuses on the origins of chirality and amplification in the asymmetric autocatalysis. The mechanism of amplification of chirality in asymmetric autocatalysis will be elucidated. Asymmetric autocatalysis initiated by circularly polarized light, inorganic chiral crystals, chiral crystal of achiral organic compounds, chiral compounds due to isotope substitution, and the symmetry breaking by spontaneous absolute asymmetric synthesis are performed. It is planned to examine the spatiotemporal chiral propagation in asymmetric autocatalysis and to elucidate how chiral surface induces the chirality in asymmetric autocatalysis.

【Expected results】

Asymmetric autocatalysis is expected to be realized initiated by chiral inorganic crystal, chiral crystals of achiral organic compounds, circularly polarized light, chiral compounds due to isotope substitution. Symmetry breaking by spontaneous absolute asymmetric synthesis will be established by employing the present asymmetric autocatalysis. The mechanisms of amplification of chirality by asymmetric autocatalysis and of asymmetric induction on chiral surfaces will be elucidated. The research on asymmetric autocatalysis is expected to provide a chemical model for the elucidation of the origins of chirality and its amplification: which have been long-standing problems.

【References by the principal investigator】

- T. Kawasaki, K. Suzuki, Y. Hakoda, K. Soai, Achiral Nucleobase Cytosine Acts as an Origin of Homochirality of Biomolecules in Conjunction with Asymmetric Autocatalysis. *Angew. Chem. Int. Ed.*, **2008**, *47*, 496-499.
- K. Soai, T. Kawasaki, “Asymmetric Autocatalysis with Amplification of Chirality,” in “Topics in Current Chemistry: Amplification of Chirality,” Ed. by K. Soai, Springer, Berlin, **2008**.

【Term of project】 FY2008－2012	【Budget allocation】 **159,200,000 yen** (direct cost)

【Homepage address】 http://www.rs.kagu.tus.ac.jp/soai/

Switching Phenomena in Super-Paramagnets Controlled by External Stimuli

Masahiro Yamashita
(Tohoku University, Graduate School of Science, Professor)

【Outline of survey】

Switching phenomena in the super-paramagnets or quantum molecular magnets controlled by external stimuli, such as photo-irradiation, an electric field, a magnetic field, pressure, etc., will be investigated in order to realize the quantum effect phenomena and its application to molecule-based quantum magnets.

In this research project, we will focus on the following subjects:

1) Photo-induced switching between single-molecule magnets and single-chain magnets by using bridging spin-crossover complexes.
2) Electrical conducting single-molecule magnets and single-chain magnets.
3) Photo-induced switching between quantum molecule magnets and classical magnets by using photochromic bridging molecules.

【Expected results】

By applying external stimuli, such as photo-irradiation, an electric field, a magnetic field, pressure, etc, the switching phenomena between single-molecule magnets and single-chain magnets and between quantum molecule magnets and classical magnets will be realized. Moreover, it should be possible to prepare electrical conducting single-molecule magnets with high blocking temperatures or quantum GMR.

【References by the principal investigator】

- H. Miyasaka, A. Saitoh, M. Yamashita, and R. Clerac, "A $Mn_2^{III}Ni^{II}$ Single-Chain Magnet Separated by a Thick Isolating Network of BPh_4^- Anions", *J. Chem. Soc., Dalton Trans.*, 2422-2427(2008)
- T. Kajiwara, I. Watanabe, Y. Kaneko, S. Takaishi, N. Kojima, and M. Yamashita, "Direct Observation of the Ground Spin Alignment of Fe(II)-Fe(III) Single-Chain Magnet by Muon Spin Relaxation", *J. Am. Chem. Soc.*, 129, 12360-12361(2007)
- A. Saitoh, H. Miyasaka, M. Yamashita, and R. Clerac, "Direct Evidence of Exchange Interaction Dependence of Magnetization Relaxation in a Family of Ferromagnetic-Type Single-Chain Magnets", *J. Mater. Chem.*, 17, 2002-2012(2007)
- H. Hiraga, H. Miyasaka, K. Nakata, T. Kajiwara, S. Takaishi, Y. Ohshima, H. Nojiri, and M. Yamashita, "Hybrid Molecular Materials Exhibiting Single-Molecule Magnet Behavior and Molecular Conductivity", *Inorg. Chem.*, 46, 9661-9671(2007)

【Term of project】 FY2008-2012	【Budget allocation】 **164,400,000 yen** (direct cost)

【Homepage address】 http://coord.chem.tohoku.ac.jp/~sakutai/

Development and Control of Highly Efficient Catalytic Systems for Cross- and Multicomponent-Coupling Reactions

Nobuaki Kambe

(Osaka University, Graduate School of Engineering, Professor)

【Outline of survey】

Transition metal catalyzed bond forming reactions are among the most useful and reliable methods for organic synthesis that have been widely employed in synthetic reactions. However there still remain many unsolved problems and undeveloped areas in this field of chemistry. For example, alkyl halides, silyl chlorides, and some heteroatom compounds including organochalcogenides have been considered to be difficult to use as the reagents in transition metal catalyzed reactions. The present project aims at developing new catalytic systems of cross coupling and multi component coupling to attain efficient carbon-carbon and carbon-heteroatom bonds formation by use of these compounds. To reach these goals our studies are focused on the catalytic reactions involving anionic transition metal complexes as the active key species and also on the synthesis and application of dynamically flexible ligands for transition metals as well as the mechanistic details of the reactions that are essential to control these reactions.

【Expected results】

The present research project will provide a new method for controlling the carbon-carbon and carbon-heteroatom bond forming reactions. These results lead to the development of the useful synthetic methodologies for creating novel materials possessing new functions. A significant progress will be expected not only in synthetic applications but also in the fundamental inorganic chemistry as well as in the field of catalyst design by way of studying anionic metal intermediates. In addition, creation and application of new flexible ligands for transition metal intermediates will contribute a lot to the development of new catalytic reactions.

【References by the principal investigator】

・Ni-Catalyzed Alkylative Dimerization of Vinyl Grignard Reagents Using Alkyl Fluorides. Terao, J.; Watabe, H.; Kambe, N. *J. Am. Chem. Soc.*, **2005**, *127*, 3656-3657.
・Palladium-Catalyzed Intramolecular Selenocarbamoylation of Alkynes with Carbamoselenoates: Formation of α-Alkylidene-β-lactam Framework. Toyofuku, M.; Fujiwara, S.-i.; Shin-ike, T.; Kuniyasu, H.; Kambe, N. *J. Am. Chem. Soc.*, **2005**, 127, 9706-9707.
・ Cu-Catalyzed Cross-Coupling Reaction of Grignard Reagents with primary-Alkyl Chlorides: Remerkable Effect of 1-Phenylpropyne. Terao, J.; Todo, H.; Begum, S. A.; Kuniyasu, H.; Kambe, N. *Angew. Chem. Int. Ed.* **2007**, *46*, 2086-2089.

【Term of project】 FY2008－2012	【Budget allocation】 122,700,000 yen (direct cost)

【Homepage address】 http://www.chem.eng.osaka-u.ac.jp/~catsyn/

Synthesis of Conjugated Polymers with Higher-Ordered Helical Structures in Helicity-Controllable Liquid Crystal Field and Their Functional Properties

Kazuo AKAGI

(Kyoto University, Graduate School of Engineering, Professor)

【Outline of survey】

Currently, we succeeded in synthesizing helical polyacetylene (H-PA) with super-hierarchical helical structure in chiral nematic (cholesteric) liquid crystal (N*-LC). The N*-LC is prepared by adding a small amount of chiral compound, as a chiral dopant, into nematic liquid crystal. The synthesis using the N*-LC enabled us to control the helical sense of polymer product, by selecting the helicity of the chiral compound. Besides, the present method is applicable for not only chemical polymerizations but also electrochemical polymerizations, leading to various types of helical conjugated polymers.If the helical sense and helical pitch of the N*-LC is controllable by an external perturbation such as temperature and light, those of the resultant polymer can be easily controlled by using one kind of N*-LC as an asymmetric reaction field.The present study is aimed to construct novel N*-LC reaction field whose helical sense is dynamically and reversibly controlled by changing only temperature or wave number of irradiating light, and also to elucidate novel functional properties derived from higher-order helical structures of the resultant conjugated polymers.

【Expected results】

(1) Advanced N*-LC reaction field, whose helical sense is controllable through temperature or light, can be constructed.
(2) Helical sense and helical pitch of the resultant polymer can be well controlled by changing only temperature or wave number of irradiating light in N*-LC reaction field.
(3) Novel functional properties, such as amplified circularly polarized luminescence and induced solenoid magnetism, might occur owing to higher-order helical structures.
(4) The present method could be a highly versatile procedure for affording helical structures to various kinds of conjugated and non-conjugated polymers.
(5) It is expected that asymmetric synthesis and polymerization using the chiral liquid crystal with dynamically controllable helical sense might largely progress as a new interdisciplinary research field.

【References by the principal investigator】

・K. Akagi, G. Piao, S. Kaneko, K. Sakamaki, H. Shirakawa, M. Kyotani, "Helical Polyacetylene Synthesized with a Chiral Nematic Reaction Field", *Science*, **282**, No. 5394, (1998) 1683-1686.
・M. Goh, M. Kyotani, K. Akagi, "Highly Twisted Helical Polyacetylene with Morphology Free From Bundle of Fibrils Synthesized in Chiral Liquid Crystal Reaction Field", *J. Am. Chem. Soc.* **129**, No. 27, (2007) 8519-8527.
・K. Akagi, "Helical Polyacetylene Synthesized in Chiral Nematic Liquid Crystal", Handbook of Conducting Polymers, Third Edition, Conjugated Polymers, Eds. T. A. Skotheim and J. R. Reynolds. CRC Press, New York, 3-3 - 3-14 (2007).

【Term of project】 FY2008 −2012	【Budget allocation】 **151,400,000 yen** (direct cost)

【Homepage address】 http://star.polym.kyoto-u.ac.jp/AkagiGHP/indexA.html

Development of Materials with Novel Properties and Functions Based on Controlled Double-Stranded Helical Structure

Eiji Yashima
(Nagoya University, Graduate School of Engineering, Professor)

【Outline of survey】

Biological polymers, such as proteins and nucleic acids, possess a characteristic single-handed α-helix and double-helix, respectively, which typically links to their sophisticated functions in living systems. Inspired by such exquisite helical structures, the design and synthesis of artificial helical polymers and oligomers with a controlled helix-sense has been attracting considerable interest in the past two decades in polymer and supramolecular chemistry. While a number of synthetic polymers and oligomers that fold into a single-stranded helical conformation have been reported, only a few structural motifs have been available for constructing double-stranded helical structures. In this research project, a variety of double- and multi-stranded helical polymers and oligomers will be designed and synthesized in order to develop functional materials with novel properties due to the double-stranded helical structure and chirality.

【Expected results】

This research project is aiming to create a variety of double-and multi-stranded helical polymers and oligomers with potential property and functionality involving molecular recognition (discrimination), catalytic activity (catalyst), and self-replication or information storage with implications for biological helicity, superstructures, and their sophisticated functions. Double-stranded helical polymers and oligomers with optical activity due to their one-handed helicity will show unique liquid crystallinity and can be used as chiral materials for separating enantiomers and for preparing single enantiomers as asymmetric catalysts.

【References by the principal investigator】

- H. Goto, H. Katagiri, Y. Furusho, and E. Yashima, Oligoresorcinols Fold into Double Helices in Water**,** *J. Am. Chem. Soc.*, **128**, 7176-7178 (2006).
- M. Ikeda, Y. Tanaka, T. Hasegawa, Y. Furusho, and E. Yashima, Construction of Double-Stranded Metallosupramolecular Polymers with a Controlled Helicity by Combination of Salt Bridges and Metal Coordination, *J. Am. Chem. Soc.*, **128**, 6806-6807 (2006).
- Y. Tanaka, H. Katagiri, Y. Furusho, and E. Yashima, A Modular Strategy to Artificial Double Helices**,** *Angew. Chem., Int. Ed.*, **44**, 3867-3870 (2005).

【Term of project】 FY2008− 2012	【Budget allocation】 **88,900,000 yen** (direct cost)

【Homepage address】 http://helix.mol.nagoya-u.ac.jp

Investigation of crystal growth mechanisms of Si crystals floating on Si melt and development of crystal growth technique to realize high-quality Si multicrystals

Kazuo Nakajima

(Tohoku University, Institute for Materials Research, Professor)

【Outline of survey】

In face of serious environmental problems, large implementation of solar cells is pursued to ensure the sustainability of future energy supply. To accomplish this, a breakthrough technology to reduce the cost of electricity production by solar cells is mandatory. To reach the goal, establishment of novel crystal growth technology to realize Si multicrystals with high-quality and high-yield is essential.

In this research, we attempt to understand fundamental crystal growth mechanisms using originally developed in situ observation system of melt growth and model crystal growth experiments, and clarify how microstructures such as grain boundaries, grain orientations, and dislocations are formed during dynamical crystallization process. The obtained knowledge will be implemented to development of a novel crystal growth technology based on “floating casting method”, which consists of nucleation at the center of the melt surface and subsequent crystal growth to minimize the contact of the crystal with the crucible wall. By this technology, we will realize high-quality Si multicrystals with low impurities and defects to be applicable to high-efficiency solar cells comparable with those based on single crystal.

【Expected results】

- Mechanisms of formation of microstructures and defects in Si multicrystals during dynamical crystallization process will be clarified through fundamental research of crystal growth.
- A novel crystal growth technology to realize high-quality Si multicrystals will be developed based on “floating cast method”.
- By using the technology, Si multicrystals to be applicable to practical solar cells with high conversion efficiency of approximately 20% will be obtained.

【References by the principal investigator】

(1) K. Fujiwara, K. Maeda, N. Usami, and K. Nakajima, “Growth mechanism of Si-faceted dendrites”, Phys. Rev. Lett. (in press).

(2) K. Fujiwara, K. Maeda, N. Usami, G. Sazaki, Y. Nose and K. Nakajima, “Formation mechanism of parallel twins related to Si-facetted dendrite growth” Scripta Materialia **57**, 81-84 (2007).

(3) K. Kutsukake, N. Usami, K. Fujiwara, Y. Nose, and K. Nakajima, “Influence of structural imperfection of Σ5 grain boundaries in bulk multicrystalline Si on their electrical activities”, J. Appl. Phys.**101**, 063509 (2007).

【Term of project】 FY2008－2010	【Budget allocation】 **114,700,000 yen** (direct cost)

【Homepage address】 http://www.xtalphys.imr.tohoku.ac.jp

Dynamic control of photonic crystal for new functionality

Susumu Noda
(Kyoto University, Graduate School of Engineering, Professor)

【Outline of survey】

The goal of this project is to dynamically control photonic crystals, which are artificial materials with periodic refractive index distributions, and to create new functionalities. Although the recent progress of photonic crystal is really remarkable, their characteristics have so far mostly been static: once the structure is made, its characteristics are fixed. If the properties of photonic crystals could instead be changed dynamically and rapidly, significant advances would be expected in areas of photonics. In this project, we realize the dynamic control of the properties of photonic crystal nanocavities and waveguides, which can generate new functionalities such as slowing/stopping light and on-the-fly dynamic wavelength change of propagating light.

【Expected results】

When the dynamic and rapid control of photonic crystals can be realized, new and novel functionalities can be developed. For example, by the dynamic control of the *Q* factor of photonic crystal nanocavities, deliberately control storage and release photons from nanocavities could be achieved. The dynamic change of the characteristics of photonic crystal waveguides could produce dynamic changes of properties of photons propagating in the photonic crystals. Through this project, we will develop a new academic field called: "*Dynamic Photonic Crystals*".

【References by the principal investigator】

・Y.Tanaka, J.Upham, T.Nagashima, T.Sugiya, T.Asano and S.Noda: "Dynamic control of the Q factor in a photonic crystal nanocavity", *Nature Materials*, Vol.6, pp.862-865 (2007).
・S. Noda, M. Fujita, and T. Asano: "Spontaneous-emission control by photonic crystals and nanocavities", Nature Photonics, Vol.1, No.8, pp.449-458 (2007).

【Term of project】 FY2008－2012	【Budget allocation】 160,100,000 yen (direct cost)

【Homepage address】 http://www.kuee.kyoto-u.ac.jp/%7Elab05/index_e.html

Semiconductor microring processor using wavelength channel control

Yasuo Kokubun
(Yokohama National University, Graduate School of Engineering, Professor)

【Outline of survey】

In the next-generation photonic network and the optical cross connect, a compact and integrated all-optical signal processing device using wavelength channel is needed for the high-speed and flexible control of signal pass. The purpose of this research project is to realize an all-optical signal processor named "semiconductor microring processor", utilizing the self-phase modulation (SPM), cross-gain modulation (XGM), and cross-phase modulation (XPM) in a microring resonator consisting of semiconductor optical amplifier (SOA). This device can realize many signal processing functions, such as the peak level limiter, signal equalization, wavelength conversion, and logic such as exclusive OR (XOR) using two different wavelength channels. In addition, if the injection current exceeds the lasing threshold, a high-speed flip-flop will be possible by the injection locking in a semiconductor microring laser using two different wavelength signals.

【Expected results】

The cross connect circuit which controls the pass of high-speed and a large capacity signal transmission are essential to the chip-to-chip and intra-board interconnects as well as photonic networks. However, the electronic routing is approaching the limit of speed and power consumption, thus all-optical signal routing will be necessary within 5-10 years. The realization of the microring processor will open up a new era of photonic routing, enabling the high-speed all-optical control of high bit rate optical signal higher than several tens Gbps by a compact integrated device.

【References by the principal investigator】

- Y. Goebuchi, M. Hisada, T. Kato, Y. Kokubun, "Optical cross-connect circuit using hit-less wavelength selective switch", *Optics Express*, vol.16, no.2, pp.535-548, 2008.
- Y. Kokubun, "High index contrast optical waveguides and their applications to microring filter circuit and wavelength selective switch," (Invited), *IEICE Trans. Electronics*, vol.E90-C, no.5, pp.1037-1045, May 2007.

【Term of project】 FY2008－2012	【Budget allocation】 138,700,000 yen (direct cost)

【Homepage address】 http://www.dnj.ynu.ac.jp/kokubun-lab/index.html

Study and Development of Extremely Short Pulse Coherent Terahertz Light Source Employing an Electron Isochronous Ring

Hiroyuki Hama
(Tohoku University, Graduate School of Science, Professor)

【Outline of survey】

Terahertz radiation, located between the light and the microwave, is in wavelength region from several tens micro m to a few mm. Energy levels of interacting molecules and collective vibration of DNA and other biological molecules are in this frequency region, so that, in the photo-life science filed, Terahertz radiation has received much attention as a new non-ionizing probe light for investigation of global structure of protein. Though Terahertz radiation is a frontier area in other many scientific fields, sources of high quality radiation in this region have been scarce.

In this study, a light source accelerator system for multi users will be established. Electron bunches with bunch length less than 100 fs produced by an advanced linac are injected into an isochronous ring where the bunch form factor is preserved in whole ring, and then coherent synchrotron radiation of Terahertz region can be provided from every bending magnet. Two major key issues to be investigated are production of extremely short electron bunches and non-linear beam optics for complete isochronous system.

【Expected results】

Providing intense Terahertz radiation from the isochronous ring for multi users, Terahertz science will be progressed like a synchrotron radiation facilities. Employing light source based on conventional lasers and sharing common technologies among users, the facility will be evolved uniquely. In addition, since Terahertz radiation is able to be converted to soft X-ray via Compton backscattering, novel combination of probe photons is expected to open a door of new research fields.

【References by the principal investigator】

- “CONCEPTUAL DESIGN OF AN ISOCHRONOUS RING TO GENERATE COHERENT TERAHERZ SYNCHROTRON RADIAION”, H. Hama, H. Tanaka, N. Kumagai, M. Kawai, F. Hinode, T. Muto, K. Nanbu, T. Tanaka, K. Kasamsook, K. Akiyama, M. Yasuda, New J. of Phys. 8 (2006) 292 – 307.

【Term of project】 FY2008− 2012	【Budget allocation】 159,300,000 yen (direct cost)
【Homepage address】	http://www.lns.tohoku.ac.jp/~acc/

Plastic Physics of Defect Mechanics

Yoji Shibutani
(Osaka University, Graduate School of Engineering, Professor)

【Outline of survey】

Basic mechanism of plastic deformation of the ductile materials should be reduced to the behavior of the line defect of dislocation. However, linkage to the macroscopic plasticity f such a basis might be achieved only if the huge number of defects can be managed and the extremely complicate interactions between the line and the line defects, or the line and the planar defects of surface and grain boundary can be fully understood. The present project aims at investigating and synthesizing such defect interactions using nanoindentation which can realize the almost ideal collective dislocation nucleation in the statistically defect-free region. Especially, the interaction of the emitted dislocations to the grain boundary is emphasized, which is key issue of the defect-controlled mechanics for enhancement of the materials strength. The properties of the displacement burst, which is the nanoscopic abrupt increase of the indent depth due to the collective dislocation emission, provide the various roles of grain boundary; piling-up of dislocation, absorption, or dislocation source. These are summarizing from the experimental mechanics for finding out the real interaction and also from the computational mechanics for tracing the defect dynamics.

【Expected results】

One of the recent demands to the engineering field is to design the safer and the more relieved structures to the natural and the artificial disasters, and also the structures with a log life to save the resources. The achievements of the present project are much expected to give the basic understanding of the fracture and the unstable finite irreversible deformation of the matters. It can cover the semiconductor field where only one line defect is never allowed for reliability and also the sheet metal forming process of the automobile where the continuous defect field should be fully specified for more precise prediction of plastic deformability.

【References by the principal investigator】

- Y. Shibutani, T. Tsuru and A. Koyama, Nanoplastic deformation of nanoindentation: Crystallographic dependece of displacement bursts, Acta Materialia, Vol.55, 2007, pp.1813-1822.
- Y. Shibutani and A. Koyama, Surface roughness on the displacement bursts observed in nanoindentation, Journal of Materials Research, Vol.19, No.1, 2004, pp.183-188.

【Term of project】 FY2008-2012	【Budget allocation】 89,700,000 yen (direct cost)

【Homepage address】 http://www-comec.mech.eng.osaka-u.ac.jp/

Development of Multi-level Tribological Simulator based on Ultra-accelerated Quantum Chemical Molecular Dynamics

Akira Miyamoto

(Tohoku University, New Industry Creation Hatchery Center, Professor)

【Outline of survey】

It is urgent to develop alternative lubricant that does not contain sulfur and phosphorus from the point of view of environmental friendly and achievement of reliable mechanics. Therefore, it is strongly demanded to establish the novel methodology to investigate dynamics behavior of lubricant as well as involved chemical reaction in nano space under friction. This needs deeply understand of fundamental of conventional additive in a lubricant and anti-wear phenomena. We have successfully developed tribochemical simulator, “Hybrid-Colors”, which enables to simulate mechanical friction with consideration of chemical reaction. On the other hand, we have recently developed ultra-accelerated quantum chemical molecular dynamics that is faster by 10 million in computational speed than conventional first-principles molecular dynamics. In this study, we challenge to develop “Multi-level Tribological Simulator” based on the ultra-accelerated quantum chemical molecular dynamics and recently developed simulators related to the tribology, which makes possible to investigate the phenomena observed in tribology field from electronic-level to macroscopic-level.

【Expected results】

In this study, “Multi-level Tribological Simulator” is developed based on both an ultra-accelerated quantum chemical molecular dynamics and recently our developed simulators. This simulator models chemical reaction under friction from electronic-level to macroscopic-level. Moreover, several utilization tools for this simulator such as potential parameter fitting simulator based on precise quantum mechanics are also developed. This developed simulator is verified by applying to practical problem of mechanochemical reaction, e.g. lubricant additive for automobile, and comparing with the experimental observation.

【References by the principal investigator】

・Michihisa Koyama, Jun Hayakawa, Tasuku Onodera, Kosuke Ito, Hideyuki Tsuboi, Akira Endou, Momoji Kubo, Carlos A. Del Carpio, and Akira Miyamoto, “Tribochemical Reaction Dynamics of Phosphoric Ester Lubricant Additive by Using a Hybrid Tight-Binding Quantum Chemical Molecular Dynamics Method”, J. Phys. Chem. B, 110 (2006) 17507-17511.

・Yusuke Morita, Tasuku Onodera, Ai Suzuki, Riadh Sahnoun, Michihisa Koyama, Hideyuki Tsuboi, Nozomu Hatakeyama, Akira Endou,Hiromitsu Takaba, Momoji Kubo, Carlos A. Del Carpio, Takatoshi Shin-yoshi, Noriaki Nishino, Atsushi Suzuki, Akira Miyamoto, “Development of a New Molecular Dynamics Method for Tribochemical Reaction and its application to formation dynamics of MoS_2 tribofilm”, Appl. Surf. Sci., in press.

【Term of project】 FY2008－2012	【Budget allocation】 153,600,000 yen (direct cost)

【Homepage address】 http://www.aki.che.tohoku.ac.jp/index-j.html

Research on Creating Function of New Lightweight Core Structure and Its Forming Method by Fusion of Computational Mechanics and Origami Engineering

Ichiro HAGIWARA

(Tokyo Institute of Technology, Graduate School of Science and Engineering, Professor)

【Outline of survey】

Lightweight core structure with high stiffness and strength must be more and more important because of resource saving. The honeycomb core is said the alias name of core structures without substitute until now despite that it is weak against heat ,week shear force and expensive ,furthermore it is difficult to be curved for shell structure. In July 2007, the Nature magazine issued the Dia-Core as a great possibility that it creates industrial applications of Japanese origami, that Nojima, the co-researcher, discovered using the origami engineering and the theory of space filling. It is necessary to both of the optimization of functions and the establishment for forming method in low price aided by computational mechanics in order that the origami engineering with high possibility applies to the industrial field certainly. The Dia-Core has been shown to be more excellent from comprehensive standpoint than honeycomb, by Nojima's and Hagiwara's researches on the strength and the stiffness, and the core was gotten the news on Japan Journal and the newspapers. Nojima has also invented many types of the original core structures with space filling type of regular polyhedron, quasi-regular polyhedron or skew polyhedron, these are quite different from the existing prismatic core model. In this research, we will establish the method for forming the Dia-Core in low price and invent to the functions of heat insulation, sound absorption and insulation, and geometry pattern designs interweaving light and shadows. In the same time, we are going to develop these forming methods.

【Expected results】

The structure of stable Dia-Core can make to destabilize by handling separation, truncation or cutout for the origami pattern and extend to deflation/deploy models like a polyhedron, a dome or a sponge type, unknown type cores will be invented by them. With aiding computational mechanics, we will develop the optimum forming methods to manufacture the best core with lightweight, high stiffness, functions of deflation/deploy, sound absorption-isolation, heat isolation and other functions. By the development, basic investigation for wide-ranging industrial applications will be progressed space structures like a solar sail, medical products like catheter, stent and artificial muscle, building and railcar floor structures, heat shield building walls, sound proof walls to prevent noise pollution and other applications. And the origami engineering triggered by Japan is recognized as valuable things to the fundamental to environmental conservation by reduction of materials, nano-technology and medical treatment.

【References by the principal investigator】

・(1) Z. Wu, I. Hagiwara and X.tao, Optimization of crush characteristics of the cylindrical origami structure, Int. Vehicle Design, Vol.43, Nos.1-4(2007), pp 66-81.
・(2) Hagiwara Ichiro, From Origami to Origamics, The Japan Journal July 2008 ,Science,pp22-25.

【Term of project】 FY2008－2012	【Budget allocation】 151,700,000 yen (direct cost)

【Homepage address】 http://www.mech.titech.ac.jp/~h-souzou/

Research and Development on Platform of Science and Engineering for Human Support Based on Real-World Haptics

Kouhei Ohnishi
(Keio University, Science and Tehcnology, Professor)

【Outline of survey】

Because the working environment of conventional industrial technologies is predetermined, those technologies are basically model-dependent. On the other hand, human-support technologies are model-independent, since those depend on the record and the characteristic of each personal body. The human-support technology that flexibly adapts to personal body characteristic must be a key technology for human supports in next generation. Since the contributions of conventional industrial technologies to human support are limited, it is necessary to create an innovative technology that flexibly support humans based on “perception” and “action” of humans.

This project proposes “science and engineering for human support” focusing on personal body characteristics. The core technology is real-world haptics which deals with touching and tactile sensation. Haptics is a secret for human support by various kinds of interactive contacts of human, robot and environment in the future life. The purpose of this project is to provide a platform for human support which realizes advanced technologies for supporting physical functions of human that differ depending on each person, extraction and copy of human skills, and so on.

【Expected results】

This project creates three novel technologies, a human-support technology based on personal body characteristics and actions, a composition technology of perceptional information, and a body characteristics database technology which records and maps environmental information and body actions. In addition, a new academic field, “science and engineering for human support” is established by integrating those three technologies. It achieves adaptable human support by converting personal sensations and actions. In other words, it realizes personalization of technologies.

【References by the principal investigator】

・S. Katsura, K. Ohnishi, et. al. “Medical Mechatronics -An Application to Haptic Forceps-,” IFAC Annual Reviews in Control, Vol. 29, No. 2, pp. 237-245, November, 2005.
・S. Katsura, K. Ohnishi: “Quarry of Modal Information from Environment for Advanced Motion Control,” IEEJ Transactions on Industry Applications, Vol. 126-D, No. 4, pp. 372-378, April, 2006.

【Term of project】 FY2008－2012	【Budget allocation】 **114,300,000 yen** (direct cost)

【Homepage address】 http://www-oml.sum.sd.keio.ac.jp/kaken-s.html

Digital Photonics –Paradigm Shift of Optoelectronics

Yoshiaki Nakano

(The University of Tokyo, Research Center for Advanced Science and Tehcnology, Professor)

【Outline of survey】

Since almost all the conventional optical devices are analog devices, whenever digital processing needs to be done, one has to convert optical signals into electrical ones, to process them by electronic circuits, and to convert the electrical signals into optical ones again. However, this current way of converting O into E and E into O every time when digitally processing ultra-fast and ultra-large-capacity optical signals will soon become unacceptable in terms of speed limitation, heat generation, large size, and, most of all, power consumption. A dream of electronics engineers has been to do the digital processing, if it is not too complicated, in the optical domain by digital optical circuits in a ultra-fast and low power dissipation manner. However, there has been no such optical device available to date.

Furthermore, while in the electronic circuits unidirectionality of signals is guaranteed by transistors, in the optical circuits the reciprocity of light allows reverse signal propagation toward upper stream if it is generated by reflection, which makes operation of sequential logic circuits unstable. In order to avoid this instability in the optical circuit, non-reciprocal devices such as optical isolators become necessary everywhere. Nevertheless, there has been no nonreciprocal device or optical isolator which can monolithically be integrated on a circuit chip, and realization of such devices has been an important research target.

In this research, we are to fabricate and develop all-optical logic gates, all-optical flip-flops, and nonreciprocal optical devices which are of low power dissipation, compact, and integratable, on the basis of semiconductor monolithic optical integrated circuit technologies that the principal investigator has been incubating, as well as to search new process technologies to monolithically integrate those different devices on a single semiconductor substrate, thereby demonstrating prototype large scale digital photonic integrated circuits (PLSIs) consisting of hundreds to thousand devices for the first time in the world at the end of the project. Through this research the era of full-scale digital photonic circuits, namely, “digital photonics” is expected to be opened up, in the world of electronics.

【Expected results】

If this research ends up in success, relatively simple front-end digital processing in ultra-high-speed optical information networks will become able to be done in the optical domain without being converted into electrical signals. As a consequence, the ever-increasing tendency of electrical power consumption for communication will be reduced by several orders of magnitudes, thereby contributing to the society significantly.

【References by the principal investigator】

・M. Raburn, Y. Nakano et al., “Integrable multimode interference distributed Bragg reflector laser all-optical flip-flops,” IEEE Photonics Technology Letters, vol. 18, no. 13, pp. 1421-1423, July 1, 2006.

・H. Shimizu and Y. Nakano, “Monolithic integration of a waveguide optical isolator with a distributed feedback laser diode in the 1.5-μm wavelength range,” IEEE Photonics Technology Letters, vol. 19, no. 24, pp. 1973-1975, December 15, 2007.

【Term of project】 FY2008– 2012	【Budget allocation】 122,900,000 yen (direct cost)

【Homepage address】 http://www.ee.t.u-tokyo.ac.jp/~nakano/lab/

BioCMOS technology and its application to portable biosensor instruments

Kazuo Nakazato
(Nagoya University, Graduate School of Engineering, Professor)

【Outline of survey】

Semiconductor integrated circuits are the base of present information and communications technologies, and have been developed exponentially in this half century, and are expected to be continuously developed in future. During such development the merit of integrated circuits, such as miniaturization, low power consumption, and system on a chip, could be utilized for not only information and communications but also medical, health, and environmental applications. The purpose of this research is to establish BioCMOS technology, combining semiconductor integrated circuits technology with biotechnology, and to pave the way for the application of semiconductor integrated circuits to medical and health fields. To realize BioCMOS chips detecting specific DNA sequences, proteins, and cells, (1) interdisciplinary research on macromolecules-flui semiconductor system, (2) sensor interface circuits, (3) sensor system on a chip, and (4) assembling technology will be developed. During the research, biosensor chips will be fabricated, tested, and assembled. Laboratory prototype will be constructed to prospect the medical and health applications.

【Expected results】

Moving into aging and mature society, interest in health and medical care is increasing. In 2010, ten thousand and seven hundred billion yen market is expected in Japan for demand of solving anxiety to health (realization of new medical system by innovation, Industrial Structure Advisory Council, Japan, December, 2001). BioCMOS chip could realize portable biosensor instruments, which everybody can operate anytime for health care based on individual constitution and early detection of infections and cancers, so medical care in home or at the place staying and food inspection at shopping floor may become possible.

【References by the principal investigator】

・K. Nakazato, M. Ohura, and S. Uno, "CMOS cascode source-drain follower for monolithically integrated biosensor array," IEICE Trans. Electron., E91-C, No. 9, (Sep. 2008) (in press)
・K. Nakazato, M. Ohura, and S. Uno, "Source-drain follower for monolithically integrated sensor array," Electronics Letters, 43, No.23, pp. 1255-1257, (Nov. 2007)

【Term of project】 FY2008－2012	【Budget allocation】 75,700,000 yen (direct cost)

【Homepage address】 http://www.nuee.nagoya-u.ac.jp/labs/nakazatolab/
http://biocmos.com/

An implantable chip with integrated microprobe/tube arrays for electrical neural recording, stimulation, and drug delivery applications

Makoto Ishida
(Toyohashi University of Technology,
Department of Electrical and Electronic Engineering, Professor)

【Outline of survey】

The goal of this project is to develop technologies for integration of very fine out-of-plane silicon microprobe, silicon-dioxide microtube arrays with microelectronics using a "selective vapor-liquid-solid (VLS) growth" technique and microfabrication processes, for use in neurophysiological applications, based on multiple electrical recording/stimulation of neurons, and local drug delivery *in-vivo*.

1. Integration of a few microns diameter low-invasive probe electrode and tube arrays for simultaneous electrical recording, stimulation, and drug delivery system in cellular level
2. Realization of the microprobes/tubes with various lengths for three-dimensional electrical measurement and drug delivery in neuronal tissue
3. On-chip CMOS interface circuitry aimed for amplifications and filtering of recorded neural signals, drug flow controller and data/power wireless transmission system

Use of microelectrode technique is still useful in neurophysiological studies, compared to other techniques such as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG), in terms of spatial and temporal resolutions. Recent interest in this field also includes chemical analysis of neurons with particular solutions/drugs into tissue, that has been realized by penetrating microtube based drug delivery. As know that earlier groups, University of Michigan and others, have well contributed to the developments of microelectrode/tube devices, establishing a lot of techniques, and several devices have already been commercially available. Although these devices have opened up new class of neuroscience fields, fabrication techniques of the electrodes are still developing, such as minimization of probe/tube size. Conventional fabrication technologies can realize probe/tube sizes in more than tens of microns, which are relatively large compared to a single cell body with the diameter of several microns. These probe/tube devices cause damage to neurons as well as the tissue while the probes/tubes are inserted. Additionally, the spatial separation of their probes/tubes is limited to be several hundreds of microns due to the scaling limitation of the fabrication techniques. To overcome the above device issues, we plan to develop an implantable microchip with the integrated microprobe/tube arrays by utilizing the selective VLS growth.

【Expected results】

From these advantages of the size of probe/tube, high-density probe/tube array, 3-dimensional measurements in tissue, and on-chip CMOS interface capability, the proposed device could become an effective technique for neural recording/stimulation and drug delivery *in-vivo/in-vitro*, and it could greatly assist in the problem of understanding of the nervous systems.

【References by the principal investigator】

・M. Ishida, *et.al.*, Int. conf. Transducers' 99, 1999
・T. Kawano, *et.al.*, Int. conf. IEEE-IEDM, 2004
・K. Takei, *et.al.*, Journal of Micromechanics and Microengineering, 18, 3, 501-509, 2008

【Term of project】 FY2008－2012	【Budget allocation】 **161,900,000 yen** (direct cost)

【Homepage address】 http://www.dev.eee.tut.ac.jp/ishidalab

Prediction of Ultimate Performance of Civil Infrastructure using Dense Vibration Monitoring

Yozo FUJINO

(The University of Tokyo, Graduate School of Engineering, Professor)

【Outline of survey】

Based upon various techniques developed by the principal investigator, this project aims at clarifying ultimate performance of civil infrastructure such as bridges, using the data from highly dense vibration monitoring. It also attempts to include prediction of unexpected failure modes of infrastructure. The main focuses are:

1) Development of a structural health monitoring system utilizing data from sensor -installed moving objects (e.g. trains and automobiles)
2) Development of identification of external disturbance as well as structural system
3) Development of prediction methods of structural performance under extreme events from the vibration monitoring under moderate events.

【Expected results】

The traditional approach of assessing performance of civil infrastructure based on many assumptions will be replaced, at least partly, with evidence from the data from the sensors and .the reliability and safety of existing civil structures will be greatly increased. Various monitoring systems using wireless sensors and sensing data from moving objects are also to be developed

【References by the principal investigator】

- Fujino,Y. and T.Noguchi: Sustainability of Urban Stock, Goho-Do Publisher, pp.1-356, 2007
- T.MIYASHITA, H.ISHII, Y.FUJINO, T.SHOJI and M.SEKI: Understanding of high-speed-train -induced local vibrations of a railway steel bridge using Laser measurement and the effect of train speed., J. of JSCE, Vol. 63, No.2, pp.277-296, 2007.
- M.Siringoringo, Y.Fujino: Observed dynamic performance of the Yokohama- Bay Bridge from system identification using seismic records, J. of Structural. Control and Health Monitoring. **13**, 1, pp 226-244, 2006.
- Nagayama, T., Abe, M., Fujino,Y. and Ikeda,K.: Structural identification of non-proportionally damped system and its application to a full-scale suspension bridge, J. of Structural. Engineering, ASCE, Vol. **131**, No. 10, pp. 1536-1545, 2005

【Term of project】 FY2008－2012	【Budget allocation】 **75,100,000 yen** (direct cost)

【Homepage address】 http://www.bridge.t.u-tokyo.ac.jp/

Interdisciplinary Research on Architecture and Urban Environment of Ancient Greek Cities of Messene and Phigalia

Juko Ito

(Kumamoto University, Graduate School of Science and Technology, Professor)

【Outline of survey】

1) Archaeological excavation and architectural survey of Phigalia

Phigalia, an ancient city in Greece, is located in Peloponnesos and ca.100 km down to the south from Olympia. It occupies the area of 2.5km (E-W) by 1.5km (N-W) and there had been many public buildings like temples, theater, gymnasium, etc, but has never been excavated systematically. Our project of five years is to excavate the city site to expose the ancient urban and building remains. Thus, we make clear the urban structure together with the individual architecture.

2) Architectural Survey of the theater at Messene

We have already surveyed and studied some of the ancient buildings in Messene. The theater was newly excavated recently by a Greek archaeologist, and left unstudied. We are going to study its architectural remains, measuring and drawing the plans, elevations, sections to reconstruct the upper structure which was already gone.

【Expected results】

The study is wholesome including architectural history, archaeology and art history based on excavations. Especially, the excavation of Phigalia, which is the archaeologically virgin site, is the first trial and epoch-making not only for Greece but also for Japan. The works at the sites will provide many opportunities for young researchers to train themselves. Without the direct exposure to the fields and objects, the study of ancient things is going to be simply theoretical without proof. Thus, our project will make great academic contributions to the Greek studies in the future.

【References by the principal investigator】

- J. Ito, et al. “New Measurements and Observations of the Treasury of Massaliotes, the Doric Treasury and the Tholos in the Sanctuary of Athena Pronaia at Delphi” 2 vols, 2004
- J. Ito, “A Concave Conical Roof on the Square Grave Monument I at the Hellenistic Site of Messene ” G. Lavas, ed., *Sto Belos tou* Xronou, University Studio Press, Athens, 2005, pp. 307-310
- Y. Yoshinobu, J. Ito, R. Yoshitake, “International Cooperative Research of the Architecture of Asklepieion at Ancient Messene” Report for JSPS Grant-in-Aid, No.16254005 (Head: Ito), 212 pages, 2007

【Term of project】 FY2008－2012	【Budget allocation】 92,800,000 yen (direct cost)

【Homepage address】 http://www.arch.kumamoto-u.ac.jp/itoj_lab/home.html

Fabrication and Industrialization of Large-Sized Bulk Metallic Glasses of Centimeter-Size Class

Akihisa INOUE

(Tohoku University, President)

【Outline of survey】

The present project aims to fabricate large-sized bulk metallic glasses of centimeter class (L-BMGs/cm) with critical diameters over 1 cm in a wide range of multicomponent alloys in Zr-, Ti-, Mg-, Lanthanide(Ln)-, Fe-, Co-, Ni-, Cu-, Pt- and Au-based systems. In order to complete this mission, we will carry out researches on the following five items. (1) Search for the most appropriate multicomponent alloy systems, (2) Development of processes and relevant techniques required to fabricate L-BMGs/cm, (3) Clarifications of peculiar local atomic arrangements and the reason for extremely high glass-forming ability of L-BMGs, (4) Predictions of appropriate compositions for the formations of L-BMGs, based on the local atomic arrangements and phase stability of these L-BMGs with the aid of computer simulation by the establishment of the appropriate computational procedures, (5) Sample tests to evaluate the properties described below. The samples are supposed to be in a metallic glassy single phase state, composite phases containing inclusions of nanometer-sized clusters, nanocrystalline phase, nanoquasicrystalline phase and dendritic crystalline phase, and their various properties are to be measured. By summarizing results for the above five items, we will be able to fabricate L-BMGs with a critical diameter exceeding several centimeters, which have not yet been obtained to date. In addition, we will understand and solve a variety of issues inherent to large-sized samples. Furthermore, we will accumulate the fundamental findings to judge the possibility to fabricate super-L-BMGs with diameters of several tens of centimeters. These fundamental researches throughout the present project will lead to further development of materials science application fields by using newly-developed L-BMGs as new base materials, and will contribute to build extremely safe and secure society where people live wealthy.

【Expected results】

We believe that the present original and novel project is able to be drafted and accomplished by our group only Accordingly, the expected results, which are to be obtained in the present project, are listed below in terms of the following three items. (1) In five years, we will produce L-BMGs/cm with critical diameters of several centimeters in various alloy systems. (2) We will fabricate these L-BMGs by utilizing extremely highly-stabilized supercooled metallic liquids as well as clarify their fundamental and functional properties. (3) During our research on these L-BMGs/cm we will establish new fundamental aspects to be used in various other fields as new engineering materials, which contribute to human society.

【References by the principal investigator】

・A. Inoue: *Stabilization of Metallic Supercooled Liquid and Bulk Amorphous Alloys*, Acta Mater., 48(2000), 279-306.

・A. Inoue: *Bulk Glassy and Nonequilibrium Crystalline Alloys by Stabilization of Supercooled Liquid: Fabrication, Functional Properties and Applications (Part 1)*, Proc. Jpn. Acad. Ser. B-Phys. Biol. Sci., 81(2005), 156-171.

【Term of project】 FY2008－2012	【Budget allocation】 157,600,000 yen (direct cost)

【Homepage address】 http://www.wpi-aimr.tohoku.ac.jp/en/index.html

Nano-scale Structural Control of Cu interconnects Using An Extreme High-purity Electro-plating Process and Its Application to Next Generation Nano-scale ULSI

Jin Onuki

(Ibaraki University, College of Engineering, Professor)

【Outline of survey】

The purpose of this study is to develop an innovative technological process which yields a substantial decrease in the resistivity of Cu interconnects of less than 28nm to prevent ULSI from performance degradation. The Cu interconnects consist of both an inner conductive Cu and its outer high-resistivity barrier metal. However, lowering of resistivity by reducing the thickness of the high-resistivity barrier metal has been investigated intensively, the resistivity reduction process of inner Cu itself has not received much consideration. We have focused our attention on the purification of the Cu interconnects and investigating the forming process using a high-purity nominal 9N-Cu anode and nominal 6N-$CuSO_4 \cdot 5H_2O$ electrolyte. By utilizing a high-purity process, we have created 50nm wide Cu interconnects with grain sizes about 10% larger and with 20% lower resistivity than those made by the conventional process. Above results imply that a high-purity plating process could be a key technology for the reduction of the resistivity of Cu interconnects.

In this study, we investigate the development of the ultra-high-purity Cu anode and $CuSO_4 \cdot 5H_2O$ electrolyte about 2 orders of purity higher compared to high-purity commercial processes and also forming Cu interconnects without additives which might introduce impurities into Cu during plating. In addition, we also investigate barrier metal free process using insulator films of low-dielectric constant with barrier properties.

Our research goal is to realize the foundations of a new process for the multi-level Cu interconnect system with an innovative high-conductivity on the basis of the new technologies discussed above.

【Expected results】

The newly developed process is considered to have excellent compatibility with the LSI process, because low resistivity Cu interconnects can be obtained by only replacing conventional anodes and $CuSO_4 \cdot 5H_2O$ electrolytes with ultra-high-purity ones and by removing additives from electrolyte. The process developed for the realization of an innovative low resistivity Cu interconnect will contribute to the advance of Japanese LSI manufacturing industries and creation of a new electronic and information industry with low electric consumption. This is indispensable for the preservation of global environment.

【References by the principal investigator】

・S.Tashiro,K.P.Khoo,T.Nagano,J.Onuki,Y.Chonan,H.Akahoshi,T.Tobita,M.Chiba,K.Ishikawa and N.Ishikawa, “The Development of an Innovative Process of Large-Grained and Low Resistivity CuWires for less than hp45nm ULSI”, In Proc.International Interconnect Technology Conference,pp.46-48,June 2007.

・Jae-Won Lim, K.Mimira and M.Isshiki,“Precise impurity analysis of Cu film by GDMS”,Appl. Phys.A80,1105-1107,2005.

【Term of project】 FY2008－2012	【Budget allocation】 **161,300,000 yen** (direct cost)

【Homepage address】 None

Synthesis of organic-inorganic hybrid nanoparticles by surpercritical fluid and thermodynamics and unit operation of hybrid nanoparticles

Tadafumi Adschiri

(Tohoku University, Advanced Institute for Materials Research, Professor)

【Outline of survey】

Metal oxide nanoparticles are expected to be used in various applications, because theoretical prediction suggests that the hybridization of metal oxide nanoparticles with polymers, antibodies, and metal nanoparticles results in the advanced functions. However, nanoparticles are readily aggregated due to their high surface energy. On the other hand, the hybridization with other materials required designed surface chemical properties of metal oxide nanoparticles. Based on these increasing demands, we plan to develop our surface modification technique to hybridize metal oxide nanoparticles with organic molecules. We then design and control the affinity of metal oxide nanoparticles with other materials. These modified surface properties are characterized through phase behavior of metal oxide nanoparticles in liquid media. The developed technique is also used to build hetero-nanoassemblies of metal oxide and metal nanoparticles.

【Expected results】

This research allows easier handling of metal oxide nanoparticles and hybridization with other materials, which accelerate the collaborative research with other groups. The results also contribute to the fundamental knowledge of unit operation of the nanoparticles. The results also reveal the mechanism of organic-inorganic hybridization and thermodynamic aspects of surface-modified metal oxide nanoparticles.

【References by the principal investigator】

- D. Rangappa, T. Naka, A. Kondo, M. Ishii, T. Kobayashi, T. Adschiri, “Transparent $CoAl_2O_4$ Hybrid Nano Pigment by Organic Ligand-Assisted Supercritical Water,” *J. Am. Chem. Soc.* **129**, 11061-11066 (2007).
- J. Zhang, S. Ohara, M. Umetsu, T. Naka, Y. Hatakeyama, T. Adschiri, “Coll oidal Ceria Nanocrystals: A Tailor-Made Crystal Morphology in Supercritical Water,” *Adv. Mater.* **19**, 203-206 (2007).

【Term of project】 FY2008－2012	【Budget allocation】 **152,500,000 yen** (direct cost)

【Homepage address】 http://www.tagen.tohoku.ac.jp/labo/ajiri/index-j.html

Synthesis of Fuels and Chemicals by Catalytic Conversion of Inedible Biomass

Atsushi Fukuoka
(Hokkaido University, Catalysis Research Center, Professor)

【Outline of survey】

Great attention has been paid to the utilization of biomass as chemical resources to combat global warming and a rapid increase of crude oil price. Our goal is the efficient use of resources and energy in chemical processes by using heterogeneous catalysts, and we have recently succeeded in the first selective cracking of cellulose under hydrogenolysis conditions over supported metal catalysts. Purpose of this project is to synthesize metal nanoparticles and acid/base sites in ordered mesoporous materials and to evaluate their catalysis in conversion of inedible biomass into fuels and chemicals. Until now, biomass conversion has been studied using enzymes, sulfuric acid, etc., but we aim to develop new environmentally-benign catalytic processes with high efficiency. Research items include the development of selective conversion of cellulose, hemicellulose, glycerol and sorbitol and the design of multifunctional catalysts consisting of metal nanoparticles and acid/base sites in the mesoporous materials.

【Expected results】

Heterogeneous catalysis takes advantage of wide application scope of chemical processes, and we can expect to develop highly efficient reactions for conversion of biomass and sugar-related compounds. The catalytic processes for utilizing inedible biomass will be extremely effective to combat global warming. Furthermore, the synthesis of the multifunctional catalysts consisting of acids, bases and metal nanoparticles would show general guidelines for rational design of environmentally-benign green catalysts.

【References by the principal investigator】

- A. Fukuoka, J. Kimura, T. Oshio, Y. Sakamoto and M. Ichikawa, “Preferential Oxidation of Carbon Monoxide by Platinum Nanoparticles in Mesoporous Silica”, *J. Am. Chem. Soc.*, **129** (33), 10120-10125 (2007).
- A. Fukuoka and P. L. Dhepe, “Catalytic Conversion of Cellulose into Sugar Alcohols”, *Angew. Chem. Int. Ed.*, **45** (31), 5161-5163 (2006).

【Term of project】 FY2008－2012	【Budget allocation】 **143,700,000 yen** (direct cost)

【Homepage address】 http://www.cat.hokudai.ac.jp/fukuoka/index.htm

Development of Kinetic Integrated Simulation Code for Toroidal Plasmas

Atsushi FUKUYAMA
(Kyoto University, Graduate School of Engineering, Professor)

【Outline of survey】

The construction of the International Thermonuclear Experimental Reactor (ITER) has started and the Broader Approach (BA) activities aiming at early realization of fusion energy are in progress. In order to accurately predict the behavior of burning fusion plasmas and to develop reliable schemes controlling them, the development of integrated simulation codes for burning plasmas is urgently needed. Fusion reactions and external plasma heating and control modify the velocity distribution functions of electrons and ions and affect transport phenomena and various instabilities as well as the heating and current-drive efficiencies. The aim of this research project is to develop a kinetic integrated simulation code based on the time evolution of the velocity distribution functions and, through the time-dependent integrated analysis of toroidal plasmas including non-axisymmetric effects, to conduct the performance prediction of burning plasmas and the development of control schemes. This project will also contribute to the international collaboration for the development of ITER integrated modeling codes and the domestic collaboration for the code development intended for computer simulations in the BA activities.

【Expected results】

The integrated modeling code, TASK, describing the time evolution of toroidal plasmas will be upgraded by implementing advanced physics models, such as kinetic analyses based on the time-evolution of the velocity distribution functions and three-dimensional analyses including non-axisymmetric effects, and high-performance computing with distributed parallel processing. After validation of the physics models by comparing simulation results with experimental observations, the upgraded code will be used for performance prediction, planning of operation scenario and development of control schemes, of burning plasmas.

【References by the principal investigator】

- A. Fukuyama, M. Yagi: Burning Plasma Simulation Initiative and its Progress, Journal of Plasma and Fusion Research, **81** (2005) 747-754 [in Japanese].
- M. Honda, A. Fukuyama: Dynamic transport simulation code including plasma rotation and radial electric field, Journal of Computational Physics, **227** (2008) 2808-2844.

【Term of project】 FY2008− 2012	【Budget allocation】 **75,800,000 yen** (direct cost)

【Homepage address】 http://bpsi.nucleng.kyoto-u.ac.jp/kisc/en/

Production and Control of Super-Dense Plasmas towards an Innovative Ignition Regime for a Fusion Reactor

Hiroshi Yamada

(National Institute for Fusion Science, Department of Large Helical Device Project, Professor)

【Outline of survey】

The goal of this project is to propose a scientific model for ignition with super-high density and low temperature, which is different from the conventional scenario with low density and high temperature. Fusion plasmas with super-high density and low temperature reduce serious heat load on the first wall and improve performance of confinement including fusion products, i.e., alpha particles. Consequently, this scenario is expected to mitigate the requirements of a fusion reactor.

We have found the operational condition whereby particle diffusion is suppressed in the experiment with highly efficient fueling by solid hydrogen pellets on the Large Helical Device. The plasma density has reached 10 times 10 to the 21st per cubic meter, which is ten times higher than the usual breakeven condition.

This project tackles elemental issues, i.e., establishment of a control method to sustain super-high density plasmas in steady state, impurity screening consistent with helium ash exhaust, reduction of heat load on the wall by control of detached plasmas and clarification of confinement properties required for the control of a thermal instability in a fusion reactor. We aim at an innovative ignition scenario with a temperature of 80 million degrees and a density of 6 times 10 to the 20th per cubic meter of the density in contrast to the conventional scenario with 200 million degrees and 1.5 time 10 to the 20th per cubic meter, which is anticipated to reduce the engineering demands in a fusion reactor.

【Expected results】

The goal is establishment of an operational regime which cannot be realized in tokamaks such as ITER. This innovative approach is possible by scientific exploration only in helical system.

The anticipated outcome of this project has the potential to mitigate these requirements significantly. Progress in key elements suggested by the scientific results to date will provide sufficient materials to assess the applicability of a super-dense plasma to a fusion reactor.

【References by the principal investigator】

- H.Yamada et al., "*Characterization and Operational Regime of High Density Plasmas with Internal Diffusion Barrier Observed in the Large Helical Device*" Plasma Physics and Controlled Fusion, Vol.49, pp.487-496 (2007)
- R.Sakamoto et al., "*Repetitive Pellet Fueling for High-Density/Steady-State Operation on LHD*" Nuclear Fusion, Vol.46, pp.884-889 (2006)

【Term of project】 FY2008－2012	【Budget allocation】 122,200,000 yen (direct cost)

【Homepage address】 http://iis.lhd.nifs.ac.jp

Functional Analysis of Newly-found Actin Structure Involved in Chloroplast Photorelocation Movement

Masamitsu Wada
(Kyushu University, Faculty of Sciences, Professor)

【Outline of survey】

Chloroplasts move towards weak light to absorb more light to perform efficient photosynthesis but escape from strong light to avoid photodamage of chloroplasts. Arabidopsis plants deficient in the avoidance response cannot survive under direct sunlight in mid summer. Light condition, such as fluence rate and wavelength changes frequently according to the circumstances where plants live, so that to make full use of light is the first priority matter for plant life. Plants use light as information to monitor environmental conditions as well as energy source for photosynthesis. For that purposes chloroplasts monitor the light environment through blue light receptor, phototropin family proteins. Recently we found an actin fine structure that involves on chloroplast photorelocation movement. Our study will focus on the function of the actin structure for chloroplast movement.

【Expected results】

Actin filaments involve not only in muscle function in animals but also in various physiological phenomena such as organelle movement both in animal and plant cells. Two types of actin-dependent organelle movement are reported so far, one is dependent on molecular motor myosin and the other is depend on actin-network system mediated by ARP2/3 proteins. The actin structure that we found in chloroplast movement is the third category of actin-dependent systems. Our study will be able to clarify the mechanism of chloroplast movement, and, moreover, add a new concept on actin function how successfully organisms have evolved and developed the actin-dependent organelle movement.

【References by the principal investigator】

・Kagawa *et al.* (2001) Arabidopsis NPL1: A phototropin homologue controlling the chloroplast high-light avoidance response. *Science, 291*, 2138-2141.
・Kasahara *et al.* (2002) Chloroplast avoidance movement reduces photodamage in plants. *Nature, 420*, 829-832.
・Wada *et al.* (2003). Chloroplast movement. *Annu. Rev. Plant Biol., 54*, 455-468.
・Oikawa *et al.* (2003) CHOLOROPLAST UNUSUAL POSITIONING1 is essential for proper chloroplast positioning. *Plant Cell, 15*, 2805-2815.

【Term of project】 FY2008− 2012	【Budget allocation】 **159,800,000 yen** (direct cost)

【Homepage address】 None

Functional Diversity of Visual Pigments and Photoreceptor cells

Yoshinori Shichida
(Kyoto University, Graduate School of Science, Professor)

【Outline of survey】

Photoreceptor cells of animals contain visual pigments that absorb light and start a light-induced signaling cascade. The functional diversification of photoreceptor cells is thought to originate from the evolution and diversification of the various functional proteins involved in this signaling cascade. Several studies have been carried out to elucidate the molecular properties of the functional proteins and their relationships with the photoreceptor cell responses. However, *in vitro* analyses of functional proteins may sometimes cause these proteins to behave in a manner that is not directly related to physiological cell responses. Therefore, further research efforts should focus on elucidating what are the molecular properties of functional proteins that originate various cellular responses. In this study, by using knock-in mice exogenously expressing a visual pigment, we will identify the amino acids that give rise to the different molecular properties of visual pigments and functional diversity of photoreceptor cells. This approach will bring light to the mechanism of molecular diversification, that in turn gives rise to the diversification of cells and individual organisms. Our approaches will bring a new perspective into the filed of biodiversity research.

【Expected results】

Light signals from the outer environment are important for many living organisms, and the relationship of diversification of animal behavior and of their habitats have been examined through the analysis of photoreceptor function of various animals. In this study we use visual pigments of photoreceptor cells to test the relationship between functional modifications of proteins and functional diversification of cells and individuals by experimental means. This type of research may open a new field in molecular physiology on the basis of functional diversification of organisms and evolution.

【References by the principal investigator】

・Sakurai et al. (2007) Physiological properties of rod photoreceptor cells in green-sensitive cone pigment knock-in mice. J. Gen. Physiol. 130(1), 21-40.
・Imai et al. (2007) Molecular properties of rhodopsin and rod function. J. Biol. Chem. 282(9) 6677-6684.
・Terakita et al. (2004) Counterion displacement in the molecular evolution of the rhodopsin family. Nat. Struct. Mol. Biol. 11(3): 284-289.
・Imai et al. (1997) Single amino acid residue as a functional determinant of rod and cone pigments. Proc. Natl. Acad. Sci. USA. 94(6): 2322-2326.

【Term of project】 FY2008− 2012	【Budget allocation】 159,800,000 yen (direct cost)

【Homepage address】 http://photo1.biophys.kyoto-u.ac.jp/

Structural basis for molecular mechanisms of substrate recognition and transport regulation by membrane transporters

Osamu Nureki

(The University of Tokyo, Institute of Medical Science, Professor)

【Outline of survey】

Membrane transporters maintain the intracellular circumstances by strictly regulating the import and export of metal ions, sugars, metabolites and drugs etc. To elucidateat an atomic resolution (A) how the transporters drive their transport, (B) how the transporters exclusively select their specific substrates and (C) how the transporters regulate their transporting activities, we will perform (1) structure determination by X-ray crystallography, (2) dynamic property analysis by MD simulation and (3) *in vivo* and *in vitro* complementary experiments, focusing on ion transporters of magnesium, iron and heavy metals, temperature-sensing cation channels, sugar transporters and multidrug transporters. Originality of this project is touncover the essential molecular mechanism of membrane transport by comparing and integrating the functional mechanisms of transporters specific for various kinds of targeted solutes.Since Nobel prizes were awarded for investigations onaquaporin and potassium channel, more and more structural analyses of membrane transporters have been reported. In this project, we will first elucidate the three main unresolved mechanisms(A)-(C) by the above strategies (1)-(3).

【Expected results】

Plasma membrane defines the cellular boundary to maintain the distinct intra-cellularcircumstances, which is essential for life. Transporters embedded in the membrane create the distinct cellular circumstances by regulating the transport of various substances. Therefore, structural and functional investigations of membrane transporters may elucidate the fundamental mechanisms of maintenance of life. Furthermore, since dysfunctions of transporter proteins are related to cardiac, renal, gastrointestinal and cranial nerve diseases, achievements of this research project may lead to medical application such as structure-based drug design (SBDD), in addition tothe scientific significance.

【References by the principal investigator】

・"Crystal structure of the MgtE Mg^{2+} transporter" M. Hattori, Y. Tanaka, S. Fukai, R. Ishitani, O. Nureki***Nature*448**, 1072-1075 (2007).

【Term of project】 FY2008−2012	【Budget allocation】 **159,900,000 yen** (direct cost)

【Homepage address】 http://www.x-ray.bio.titech.ac.jp/

Structure and dynamics of actin filament complex:
mechanism of calcium regulation of muscle contraction

Yuichiro Maéda

(Nagoya University, Graduate School of Science, Professor)

【Outline of survey】

The actin filament complex, consisting of actin, tropomyosin and troponin, plays the major roles in muscle contraction and its regulation. Transient increase of intracellular Ca^{2+} concentration induces the Ca^{2+} binding to troponin, whose signal is transferred through tropomyosin to polymerized actin, initiating the force generation (the Ca^{2+} regulation). We have so far elucidated for the first time the atomic structures of constituting proteins, troponin and tropomyosin. In this project, the atomic structure of the entire actin filament complex, as well as the structural dynamics should be elucidated, in order to elucidate the mechanism of the Ca^{2+} regulation. What are challenging in this project are, that the structure of the complex as large as 1MDa should be elucidated, and that the path should be found and established to go from the atomic structure to the structural dynamics, then further to our understanding the mechanism. Particularly, using troponin with cardiomyopathy-causing mutations, the relationship between the abnormalities of structural dynamics and the functional aberrations should be elucidated. This must be the path leading to our understanding the mechanism of calcium regulation.

【Expected results】

In this project, we are going to take innovative approaches which may be generally applicable in the biological study. First, we should construct not-naturally-occurring mini-actin filament complex of a uniform length. This is our effort to know the nature by analyzing objects which are artificially constructed, conferring the first step towards “engineering life”. Second, our project also includes developing novel procedures of analyzing structures of elongated protein complexes, which has remained under-developed in the structural biology. Third, we should establish what to measure for our understanding the structural dynamics, and find the path from the structural dynamics to our understanding the mechanism. Finally, we should shed lights on the cause of disease, based on our knowledge on the structural dynamics of the mutated protein. This may lead us to propose novel concept of structural dynamics-based drug design.

【References by the principal investigator】

- Takeda S, Yamashita A, Maeda K & Maéda Y. (2003) “Crystal structure of the core domain of human cardiac troponin in the Ca^{2+}-saturated form.” *Nature (London)*, **424**: 35-41.
- Narita A, Takeda S, Yamashita A and Maéda Y, (2006) “Structural basis of actin filament capping at the barbed-end: a cryo-electron microscopy study”, *EMBO J.* **25**:5626-33.
- Oda T, Iwasa M, Aihara T, Maéda Y , Narita A (2008) “The nature of the G- to F-actin transition” , *submitted*.

【Term of project】 FY2008－2012	【Budget allocation】 **158,200,000 yen** (direct cost)

【Homepage address】 None

Dynamics of intrinsically disordered proteins and their functional roles

Yoshifumi Nishimura

(Yokohama City University, International Graduate School of Arts and Sciences,Professor)

【Outline of survey】

In this project we will examine dynamics of intrinsically disordered proteins by using NMR and reveal their functions based on the dynamics. In eukaryotes many nuclear proteins are intrinsically disordered in their free states and upon binding to their targets, the interacting region of each protein will be folded. Especially dynamics of chromatin-related proteins, histone proteins in a nucleosome core, transcription activators, transcription repressors, and general transcription factors will be investigated in their free and target-bound states to reveal the common role of intrinsically disordered structures in transcription. For example we have already established static tertiary structures of chromodomains of chromatin remodeling factors, Chd1 and Esa1, DNA-binding domains of two telomeric proteins, hTRF1 and hTRF2 in their free and DNA-bound states, a neural restrictive silencing transcription factor, REST bound to its corepressor, mSin3, a transcription activator, ATF2, and a complex between general transcription factors, TFIIE and TFIIH by using NMR.

【Expected results】

Eukaryotic transcription factors, containing intrinsically disordered structures, regulate specific gene expression. Although classical proteins holding a specific tertiary structure interact with their targets by a simple key and lock model or an induced fit model, intrinsically disordered proteins interact with their targets by a coupled and folding mechanism. Recently some transcription factors are found to be essential for inducing iPS cell. It is very important to reveal dynamics and interacting modes of transcription factors for designing rationally iPS or ES cell. In addition histone modifications which are related to epigenetics should be revealed histone dynamics. Based on our study the basic phenomena of cell division and the maintaining mechanism of iPS or ES cell will be revealed.

【References by the principal investigator】

- Okuda, M., Tanaka, A., Satoh, M., Mizuta, S., Takazawa, M., Ohkuma, Y., and Nishimura, Y., **EMBO J.** 27, 1161-1171 (2008).
- Nomura, M., Uda-Tochio, H., Murai, K., Mori, N., and Nishimura, Y. **J. Mol. Biol.**, **354,** 903-915 (2005).

【Term of project】 FY2008－2012	【Budget allocation】 **138,000,000 yen** (direct cost)

【Homepage address】 http://www.tsurumi.yokohama-cu.ac.jp/stbiol/index.html

Molecular mechanism and regulation of assembly and remodeling of proteins

Hiroyuki Araki
(National Institute of Genetics, Department of Cell Genetics, Professor)

【Outline of survey】

Most biological reactions occur when many factors assemble on a specific region at a specific time period and express their functions. In chromosomal DNA replication, many proteins including DNA polymerases assemble on replication origins and then they are remodeled to start DNA synthesis for elongating DNA strands in a cell-cycle dependent manner. However, the molecular mechanism governing this process has not been well elucidated. In this project, we analyze chromosomal DNA replication in budding yeast as a model system, focusing on cell-cycle dependent protein assembly on replication origins and subsequent remodeling of these proteins. We purify the proteins assembling on replication origins and reconstitute an assembly in vitro. We further characterize how assembled proteins are remodeled for transition from the initiation step to the elongation step by in vivo analyses as well as reconstituted in vitro assays.

【Expected results】

We expect a break-through achievement for DNA replication research; the molecular mechanism of initiation in eukaryotic DNA replication will be revealed in this project. This is a big advancement and an epoch-making hallmark in molecular biology. We characterize protein-assembly on replication origins, which is regulated by a cell-cycle main-engine, CDK. Thus, the result leads to understanding of the cell-cycle regulation, which is often disordered in cancers and diseases. We hope that the results we will obtain in this project give clues to future characterization of cancers and genetic diseases.

【References by the principal researcher】

- Tanaka, S., Umemori, T., Hirai, K., Muramatsu, S., Kamimura, Y. and Araki, H. (2007) CDK-dependent phosphorylation of Sld2 and Sld3 initiates DNA replication in budding yeast. **Nature** 445, 328-332.
- Walter, J. C. and Araki, H. (2006). Activation of pre-replication complexes. In **DNA Replication and Human Disease** (ed. DePamphilis, M. L.), pp. 89-104, Cold Spring Harbor Laboratory Press, NY.

【Term of project】 FY2008− 2012	【Budget allocation】 153,700,000 yen (direct cost)

【Homepage address】 http://www.nig.ac.jp/section/araki/araki-e.html

Molecular Networks for the Regulation of Cell Polarization in Migrating Cells and Neurons

Kozo Kaibuchi

(Nagoya University, Graduate School of Medicine, Professor)

【Outline of survey】

In response to extracellular and intracellular signals, cell exhibits a polarized morphology with adhering neighboring cells and extracellular matrix. Cell polarization is a fundamental process that makes cells enable to exert specific physiological roles in tissues. A migrating cell has front-rear polarity for directional and persistent migration, and a neuron is highly polarized and comprised of two structurally and functionally distinct parts, an axon and dendrites. The molecular mechanisms by which cell polarization is regulated remain largely unknown. The purpose of our research is to clarify the signaling networks for the cell polarity formation and maintenance in migrating cells and neurons. Our study also aims to reveal the regulatory mechanisms of the cytoskeleton and adhesion, and a selective protein and vesicular transports involved in the cell polarization. We have been studying the Rho family small GTPases, Par complex and CRMP-2. Our research interests are focused on mode of actions of these molecules on the cell polarization.

【Expected results】

It is a fundamental issue in cell biology, developmental biology, and neuroscience to understand the control mechanisms of the cell polarization in migrating cells and neurons. Our study will provides us with whole pictures of the molecular mechanisms of the cell polarity formation, maintenance, and a selective protein and vesicular transports. We hope that our research on molecular regulatory mechanisms for cell morphogenesis sheds light on the therapeutic approaches of inflammation, atherosclerotic disease, nephritis, and psychiatric and neurological disorders.

【References by the principal investigator】

・Neuronal polarity: from extracellular signals to intracellular mechanisms. Arimura N, and Kaibuchi K, Nat Rev Neurosci, 8, 194-205, 2007

・GSK-3β regulates phosphorylation of CRMP-2 and neuronal polarity. Yoshimura T, Kawano Y, Arimura N, Kawabata S, Kikuchi A, and Kaibuchi K, Cell, 120, 137-149, 2005

【Term of project】 FY2008-2012	【Budget allocation】 150,000,000 yen (direct cost)

【Homepage address】 http://www.med.nagoya-u.ac.jp/Yakuri/

Physiological substances and functions of ABC proteins involved in lipid transport

Kazumitsu Ueda
(Kyoto University, Institute for Integrated Cell-Material Sciences (iCeMS), Professor)

【Outline of survey】

Lipids, such as cholesterol, are essential components of the body. However, their aberrant accumulation due to an excess intake, etc., causes fatal disorders such as atherosclerotic vascular lesions. Dietary lipids are absorbed from the small intestine, transported throughout the entire body via the liver, and play important roles. Recently, many members of ABC proteins, an ATP-dependent transporter family, were revealed to be involved in lipid circulation in the body and play important roles in lipid homeostasis. However, despite extensive studies, their functions and mechanisms of regulation remain unclear due to difficulties in studying large membrane proteins.

We have been intensively investigating ABC proteins for about 20 years after we identified MDR1, the first of the ABC protein genes in eukaryotes. In this project, we will reveal the physiological substances and functions of physiologically important ABC proteins on the basis of our achievements in biochemical studies on them.

【Expected results】

The functional defects of 48 human ABC proteins can lead to a variety of pathological conditions, including cardiovascular diseases, diabetes, senile blindness, respiratory failure of infants, and skin diseases. Our research on ABC proteins will contribute to human health by exploring the cause of such diseases and finding ways to prevent them. The identification of food-realted factors and chemicals affecting the functions and regulation of ABC proteins will be useful to maintain lipid homeostasis and prevent disease.

【References by the principal investigator】

- Nagao, K., Takahashi, K., Hanada, K., Kioka,N., Matsuo, M., and Ueda, K., Enhanced apoA-I-dependent cholesterol efflux by ABCA1 from sphingomyelin-deficient CHO cells. J Biol Chem. 282, 14868-74, 2007
- ABC proteins (edited by Ueda, K), Japan Scientific Societies Press, 2005

【Term of project】 FY2008－2012	【Budget allocation】 123,900,000 yen (direct cost)

【Homepage address】 http://www.biochemistry.kais.kyoto-u.ac.jp/

Studies on lipid peroxidation in human disease: its modulation from the view point of food chemistry

Teruo Miyazawa Ph. D.

(Tohoku University, Graduate School of Agricultural Science, Professor)

【Outline of survey】

Lipid hydroperoxide (LOOH) formation is well known in oxidative deterioration of edible food oils during storage and cooking. Miyazawa has considered that membrane lipid peroxidation in human body may be involved in cellular damage and senescence, life-style related disease, as well as in age-related disorders, and has carried out a series of fundamental investigations collaborating with clinical research groups.

Up to now Miyazawa et al have developed the CL-HPLC method and LC-MS/MS method for the selective and sensitive determination of LOOH present in human plasma and organ tissues, together with establishment of the synthesis method for pure LOOHs standard with high stability as to designed by protection of hydroperoxide group by the adduct formation with methoxypropene. Using these methodologies, Miyazawa et al have confirmed the membrane lipid peroxidation is closely association with several human diseases, and the evidence has been accumulated by cell culture studies, animal model researches and studies of patients with hyperlipidemia, diabetes, dementia, and skin-related diseases. To promote health benefit and disease prevention, the application of food constituents and their functionalities to modulate LOOH formation in human body is very important. We recently discovered that glycation of aminophospholipid occurs in human hyperglycemic plasma and red blood cells, and the glycated aminophospholipid causes membranous phospholipid peroxidation. We explained that the lipid glycation reaction is effectively inhibited by the presence of vitamin B6 (pyridoxal 5'-phosphate).

Considering our researches and findings, it is highly encouraged to further understand the "essential contribution of LOOH in human disease" and "prevention by food and food components of LOOH-mediated cytotoxicity and organ tissue injury". This study is aimed *1*) to develop comprehensive analytical methods of LOOH in human body, *2*) to create the universal LOOH determination method by antibody with high selectivity for LOOH, *3*) to clarify the molecular mechanism of LOOH-mediated cytotoxicity, organ tissue injury and disorders in atherosclerosis, diabetes, cancer, and dementia, and *4*) to understand the functionality of food and food constituents which can control LOOH formation in human body.

【Expected result】

Applying our original techniques for the determination of LOOH and for the preparation of LOOH standards as well as our on-going research for anti-LOOH antibody, we will try to demonstrate the dream "real determination and visualization of LOOH in human body" in the world. The results have to contribute to understand the biological significance of LOOH formation in vivo, which will serve the discovery of new functions of food and food constituents and the prevention of human disease.

【References by the principal researcher】

- K. Nakagawa, D. Ibusuki, Y. Suzuki, S. Yamashita, O. Higuchi, S. Oikawa, T. Miyazawa: Ion-trap tandem mass spectrometric analysis of squalene monohydroperoxide isomers in sunlight-exposed human skin. *J. Lipid Res.*, **48**, 2779-2787 (2007)
- O. Higuchi, K. Nakagawa, T. Tsuzuki, T. Suzuki, S. Oikawa, T. Miyazawa: Aminophospholipid glycation: a new role of pyridoxal 5'-phosphate as an inhibitor. *J. Lipid Res.*, **47**, 964-974 (2006)

【Term of project】 FY2008－2012	【Budget allocation】 155,900,000 yen (direct cost)

【Homepage address】 http://www.agri.tohoku.ac.jp/kinoubunshi/index-j.html

Improved breeding of fugu following whole genome sequencing.

Yuzuru Suzuki
(The University of Tokyo, Graduate School of Agricultural and Life Sciences,, Professor)

【Outline of survey】

Following the release of the draft human genome sequence, it was decided that the next vertebrate genome to be sequenced was tora-fugu (*Takifugu rubripes*). Until now, fugu is only commercially valuable fish species to undergo genome sequencing. Here, we report the potential application of the fugu genome database to help improve breeding efficiency in this species. The technical merit of our study lies in the use of inter-species hybridization. Individuals belonging to the second generation (F2) of progeny bred via interbreeding between tora-fugu and kusa-fugu (*Takifugu niphobles*) independently exhibit significant diversity in many phenotypes. In this study, we plan to analyze both the genomic loci and the genes responsible for each phenotype, using fine genetic linkage mapping strategies which we already established. In particular, we will focus on the genes related to the characteristics beneficial for aquaculture, such as high growth rate, disease resistance, and manageability for the commercial fish farmer.

【Expected results】

The purpose of this study is to establish strategies and methods for improved breeding in fugu by exploitation of genomic sequence database available for this species. By the end of this project, we will be able to identify several genomic loci that are responsible for beneficial phenotypes, which characterize the species differences between tora- and kusa-fugu. Among the loci studied, we will determine a number of key genes. We will then survey the individual fugu possessing superior genes with the aim of selecting desirable traits. Interbreeding of fugu species may offer the additional possibility of studying the process of evolution that results in the production of key inter-species differences.

【References by the principal researcher】

- Kai, et al., A genetic linkage map for the tiger pufferfish, *Takifugu rubripes*. Genetics, 171, 227–238 (2005).
- Kikuchi, et al., The sex-determining locus in the tiger pufferfish, *Takifugu rubripes*. Genetics. 175, 2039–2042 (2007).
- Hamuro, et al., A teleost polymeric Ig receptor exhibiting two Ig-like domains transports tetrameric IgM into the skin. J. Immunol. 178, 5682–5689 (2007).

【Term of project】 FY2008− 2012	【Budget allocation】 146,600,000 yen (direct cost)

【Homepage address】 http://www.se.a.u-tokyo.ac.jp/

Cell Turgor Measurement – Probe Electrospray Ionization (PESI) Mass Spectrometry for Molecular Profiling Techniques

Hiroshi Nonami

(Ehime University, Faculty of Agriculture, Professor)

【Outline of survey】

A cell pressure probe measures cell turgor of plants, and can extract cell solution directly from actively growing plants. The pressure probe technique and the probe electrospray ionization (PESI) mass spectrometry (MS) can be combined together in order to analyze cell molecular components in intact growing crops. By using physiological molecular information, environmental conditions can be adjusted optimally to grow crops in plant growth factories. Such a control method using physiological information to optimize energy efficiency and product quality control in plant growth factories is called as the speaking plant approach (SPA). The needle probe tip in PESI will be made to a scale as small as tens nanometers in tip diameter. The probe tip can be used to pick up molecules from cells. The thickness of cell walls of plants is about 200 nm, and if some molecules can be picked up from intact growing cells with the PESI probe, molecular components reflecting plant growth can be monitored. In the present project, the nano-precision PESI-MS technique will be developed for the purpose of introducing SPA in plant factories (i.e., Nano-Precision Agriculture).

【Expected results】

The pressure probe-combined PESI-MS will offer nano-scale resolution of molecular profiling in cells, leading to nano-precision agriculture for automated greenhouses. PESI can induce ionization of mixture samples with no special sample preparations. Nano-scale cell manipulation and MS analyses will make it possible to get physiological information for SPA in plant growth factories, resulting in high efficiency of energy usage and high quality production.

【References by the principal investigator】

・ Nonami, H. 2001. Water Relations in Plant Physiology (Japanese). Yokendo Ltd., Tokyo, pp.263.

【Term of project】 FY2008－2012	【Budget allocation】 124,300,000 yen (direct cost)

【Homepage address】 http://web.agr.ehime-u.ac.jp/%7Epbb/Grant-in-Aid%20(S).html

Studies on the phased immune-barrier systems in gut-liver axis focusing on immune responses of mesenchymal cells

Hiroshi Ozaki

(The University of Tokyo, Graduate School of Agricultural and Life Sciences, Professor)

【Outline of survey】

Gut facing directly external environments and liver directly connected to this organ possess highly developed immune systems. “Gut-Liver Axis” has recently been proposed because these organs mutually defend against the external interferences. Many of the previous studies have focused on professional immune cells. However, it still remains unknown how mesenchymal cells, distributed around the immune cells with much larger size, behave against the interferences. In this study, we attempted to hypothesizes that mesenchymal cells provide not only the spatial environment for immune cells but also play critical roles to provide immune responses after having initial activation with professional immune cells in the “Gut-Liver Axis”.

【Expected results】

In this study, we are focusing on the phenotypic changes and acquiring immune activity of mesenchymal cells (smooth muscle cells, myofibroblasts, endothelial cells, interstitial cell of Cajal etc. which line in the Gut-Liver Axis) after the inflammatory stimuli. We will produce new evidences that these mesenchymal cells might contribute to immune response by synthesizing broad range of inflammatory mediators and signaling proteins by communicating with professional immune cells. The results will provide newer strategies for the treatment of diseases characterized by inflammation of gastrointestinal tract and liver, such as inflammatory bowel disease (ulcerative colitis and Crohn’s disease: IBD), functional gastrointestinal diseases, virus hepatitis, alcoholic hepatitis, nonalcoholic steatohepatitis (NASH), and cirrhosis. The results will also pose useful method for the nutritional management and the treatment of chronic gastrointestinal diseases of domestic animals.

【References by the principal investigator】

- **Hori M, Nobe H, Horiguchi K, Ozaki H (2008)** MCP-1 targeting inhibits muscularis macrophage recruitment and intestinal smooth muscle dysfunction in colonic inflammation. **Am J Physiol** 294: C391-C401.
- **Ohama T, Hori M, Momotani E, Elorza M, Gerthoffer WT, Ozaki H (2007)** IL-1β inhibits intestinal smooth muscle proliferation in an organ culture system: Involvement of COX-2 and iNOS induction in muscularis resident macrophages. **Am J Physiol** 292: G1315-G1322.
- **Oka T, Hori M, Ozaki H (2005)** Microtubule disruption suppresses allergic response through the inhibition of calcium influx in the mast cell degranulation pathway. **J Immunology** 174, 4584 - 4589

【Term of project】 FY2008－2012	【Budget allocation】 **117,300,000 yen** (direct cost)

【Homepage address】 http://www.vm.a.u-tokyo.ac.jp/yakuri/kiban-s/

Finding of Regulatory Proteins of Microtubule Polymerization and Discovery of Natural Compounds against Dementia

Takafumi Uchida

(Tohoku University, Geaduate school of Agricultural Science, Professor)

【Outline of survey】

Japan is the world's top country for longevity, and the number of patients of dementia as Alzheimer's disease is increasing. But we have no effective drug for the disease. We created *prolyl isomerase Pin1*-knockout mice and have found that Pin1 protects against Alzheimer's disease. We think that appropriate regulation of microtubule polymerization should decrease the risk of dementia. We would like to find the proteins that regulate microtubule polymerization and elucidate their functions. The goal of this project is to discover natural compounds against dementia.

【Expected results】

We will find regulatory proteins of microtubule polymerization and elucidate the functions of them completely. In order to investigate the biological functions of them, we have been creating the knockout- and the transgenic- mice. We will use these mice to study the pathogenic mechanism of dementia. If the natural compounds that control the regulatory proteins are discovered, they will be the innovative drugs against dementia.

【References by the principal investigator】

・Takahashi K, Uchida C, Shin RW, Shimazaki,K and Uchida T.* (2008) Prolyl isomerasePin1: New findings on post-translational modifications and physiological substrates in cancer, Alzheimer's disease and asthma, ***Cell and Mol Life Sci***. 65, 359-375.

・Uchida T.*, Fanghaenel F, Uchida C, Ostroff L (2005) Prolyl isomerase Pin1 protects against age-related diseases, ***PNE***. 150 (11), 1413-1419. (Japanese)

【Term of project】 FY2008− 2012	【Budget allocation】 80,800,000 yen (direct cost)

【Homepage address】 http://www.agri.tohoku.ac.jp/enzyme/index-j.html/

Innovative Asymmetric Synthesis of Pharmaceuticals Through Strategic Development of Multifunctional and Multimetallic Catalysts

Masakatsu Shibasaki

(The University of Tokyo, Graduate school of Pharmaceutical Sciences, Professor)

【Outline of survey】

Development of pharmaceuticals involves state-of-the-art multidisciplinary researches and directly contributes to human health all over the world. Although a drug discovery research based on human genome sequence and *in silico* analysis have become more and more popular, a technology to produce complex small molecules with minimum environmental impact still constitutes a fundamental and indispensable research area. Our research group has developed several conceptually new multifunctional asymmetric catalysts to achieve highly efficient stereoselective synthesis of functionalized molecules. In the present research program, we envisioned an thorough elucidation of the origin of high catalytic activity and stereoselectivity of our multimetallic asymmetric catalysts through extensive spectroscopic analysis, leading to a new concept in the strategic development of multifunctional catalysts. These multifunctional asymmetric catalysts will boost practical synthesis of many therapeutic targets.

【Expected results】

Conventional design of asymmetric catalysts is based on the combination of one ligand—one Lewis acidic (or transition) metal. In contrast, we have designed asymmetric catalysts that constitute multi metallic center. Thus obtained multimetallic asymmetric catalysts activate multiple substrates simultaneously in theasymmetric environment, exhibiting extraordinarily high catalytic activity and stereoselectivity under mild reaction conditions. Our catalysts and newly developed catalysts in this research program will find a lot of opportunities to be applied in the practical synthesis of significant pharmaceuticals and smart materials. In particular, high catalytic activity allows for the use of non-activated substrates, which contributes to make a synthetic process atom-economical, environmentally benign and cost-effective in the industrial scale synthesis.

【References by the principal investigator】

reviews:

- Shibasaki, M.; Kanai, M. *Org. Biol. Chem.* **2007**, *5*, 2072.
- Shibasaki, M.; Kanai, M.; Matsunaga, S. *TCI Mail* **2006**, *131*, 2.
- Shibasaki, M.; Kanai, M.; Matsunaga, S. *Aldrichmica Acta* **2006**, *39*, 31.
- Shibasaki, M.; Matsunaga, S. *Chem. Soc. Rev.* **2006**, *35*, 269.

【Term of project】 FY2008-2012	【Budget allocation】 160,700,000 yen (direct cost)

【Homepage address】 http://www.f.u-tokyo.ac.jp/~kanai/index.html

Single-cell on-time molecular analysis by hyper-sensitive video-mass scope

Tsutomu Masujima
(Hiroshima University, Graduate School of Biomedical Sciences, professor)

【Outline of survey】

When we are able to analyze molecules of visualized reacting cells directly in real time, studies of molecular mechanisms of living systems will become more direct and fast. Thus we should seek a very sensitive and exhaustive molecular detection method for a single cell with simultaneous video-microscopic observation

We have developed the method to detect hundreds to thousands of small molecular MS peaks from a living single cell to extract and identify the key molecules specifically existing in a cell. We will further develop this new method as a quick methodology for findings of new medicinal molecules, new factor of differentiation for re-generative medicine and for finding new molecular mechanism of living systems.

【Expected results】

1. Acceleration of molecular mechanism analysis of living systems.
   It is already found that the results with many cells are not always true for a single cell level. It is also possible to show a full metablomics in a organelle.
2. Accelerated finding of new medicinal molecules and its task in a cell.
3. The analyses of molecular mechanism of diseases and application to diagnosis
4. Finding of new factor of cell differentiation for re-generative medicine.
5. Wide applications for nano-medicines and nano-technologies.

【References by the principal investigator】

1. Mizuno H, Tsuyama N, Harada T, Masujima T. “Live single cell video-mass spectrometry for cellular and sub-cellular molecular detection and cell classification” J. Mass Spectrometry in press (2008).
2. Tsuyama N, Mizuno H, Tokunaga E, Masujima T. “Live Single Cell Molecular Analysis by Video-Mass Spectrometry” *Anal. Sci.* **24**, 559 (2008).
3. Masujima T, Tsuyama N, Hasegawa T. “Video-visualization of dynamic cell responses and its molecular analysis for nanomedicine.” *Nanomed.* **1**, 331 (2006).
4. JP PAT No.4129587 “Mass Filter for Mass Spectrometer” and 6 applications for Pat

【Term of project】 FY2008− 2011	【Budget allocation】 160,700,000 yen (direct cost)

【Homepage address】 http://home.hiroshima-u.ac.jp/analytic//

Establishment of the basis for drug development by the analysis of molecular mechanisms of stress signaling

Hidenori Ichijo

(The University of Tokyo, Graduate School of Pharmaceutical Sciences, Professor)

【Outline of survey】

Stress response is one of the most fundamental cellular functions. Abrogation of the mechanisms of stress response leads to various human diseases including inflammation, cancer, eurodegeneration and autoimmunity. However, structural and spacio-temporal information of stress sensors as well as direct stress sensing mechanisms by proteins are largely unknown. In this study, we aim at elucidating the signaling mechanisms of stressors such as oxidative stress, Endoplasmic Reticulum stress and osmotic stress by focusing on the analysis of stress-activated ASK family kinases and their regulatory proteins. We would like to understand the mechanisms by which those physico-chemical and biological stressors are sensed by cells and converted to phosphorylation-dependent signals. The notable scientific features of this study are that we have been the front runner in the field of ASK family kinases and their regulatory proteins in stress responses and that we will perform these studies by using the forefront analytical techniques of stress signaling.

【Expected results】

We expect through this study to understand the molecular basis of stress signaling, especially sensing, recognition and conversion of cellular stressors. Our goal is also expected to lead to the development of lead chemical compounds of drugs based on our understandings of the molecular mechanisms of stress regulation of ASK family kinases. We hope accomplishment of our studies will produce fruitful results with novel principles in biology, pharmaceutical sciences and medicine.

【References by the principal researcher】

・Takeda, K., Noguchi, T., Naguro, I. and Ichijo, H. Apoptosis Signal-regulating Kinase 1 (ASK1) in stress and immune response. ***Annu. Rev. Pharmacol. Toxicol.***, 48, 199-225 (2008).

・Ichijo, H., Nishida, E., Irie, K., ten Dijke, P., Saitoh, M., Moriguchi, T., Takagi, M., Matsumoto, K., Miyazono, K. and Gotoh, Y. Induction of apoptosis by ASK1, a mammalian MAPKKK that activates SAPK/JNK and p38 signaling pathways. ***Science***, 275, 90-94 (1997).

【Term of project】 FY2008－2012	【Budget allocation】 **160,400,000 yen** (direct cost)

【Homepage address】 http://www.f.u-tokyo.ac.jp/~toxicol/index.html

Analysis of Methylome of Cancer by high throughput sequencer

Shinichi Nishikawa MD PhD
(RIKEN, Stem Cell Research Group, Group Director)

【Outline of survey】

Myelodysplasia syndrome(MDS) comprise of a diverse set of abnormalities in which both anamia and leukemia coexist. In most cases, MDS is discovered as anemia but eventually develop to leukemia. Currently, the radical cure of MDS is only attained by bone marrow transplantation, which is usually difficult to apply for an aged population. As its incidence increase as aging, MDS is an important problem in such rapidly aging countries as Japan. Recently, it was reported that a group of drugs that inhibit DNA methylation is effective for a significant proportion of MDS. As DNA methylation is an epigenetic mechanism to inhibit gene expression, this observation suggests that abnormal DNA methylation is involved in development of MDS. However, which genes are methylated during MDS development remains unclear. This is due to a technological difficulty in genome-wide analysis of DNA methylation in a quantitative manner. Recently, this problem was overcomed by a technology based on DNA array bearing entire human genome. Moreover, development of next-generation sequencer that allows sequencing of 10-100 milion base pars at one run is expected to boost the genome-wide analysis of epigenome. The major purpose of this project is to apply a high-throughput sequencers for genome-wide analysis of methylome of MDS cells who respond to the treatment with drugs inhibiting DNA methylation.Likewise, we will try to define tumor specific methylome of malignant melanoma cells.

【Expected results】

That some MDS patients undergoes remission in response to inhibitors of DNA methylation is the evidence for that abnormal methylation is involved in MDS development. Thus, comparison of the methylome of MDS cells and normal hematopoietic cells will allow us to define genes that are involved in MDS development. Through this analysis,

1) The oncogenic process of MDS and melanoma will be elucidated.
2) Genes that are involved in the development of these two tumors will be defined, which will lead to discovery of target molecules for tumor treatment.
3) The basic mechanisms underlying maintenance of stem cell systems will be elucidated.

【References by the principal investigator】

For all participants including the principal investigator, this is the first time of studying genome-wide epigenome of tumors. Hence, there is no papers directly related to this projects. However, the PI has been working on the developmental biology of hematopoietic and melanocyte stem cell systems. Followings are examples of contributions.

Samokhvalov, I.M., N.I. Samokhvalova, and S. Nishikawa. 2007. Cell tracing shows the contribution of the yolk sac to adult haematopoiesis. *Nature* 446:1056-1061.
Nishimura, E.K., S.A. Jordan, H. Oshima, H. Yoshida, M. Osawa, M. Moriyama, I.J. Jackson, Y. Barrandon, Y. Miyachi, and S. Nishikawa. 2002. Dominant role of the niche in melanocyte stem-cell fate determination. *Nature* 416:854-860.

【Term of project】 FY2008－2012	【Budget allocation】 148,700,000 yen (direct cost)

【Homepage address】 http://www.cdb.riken.go.jp/scb/

Study of *Shigella* infectious strategy for the intestinal barrier

Chihiro Sasakawa

（The University of Tokyo, The Institute of Medical Science, Professor）

【Outline of survey】

The intestinal lumen is covered by epithelial monolayer, which acts an intrinsic defensive barrier against microbial invaders. Nevertheless, many pathogenic bacteria, including *Shigella*, are capable of colonizing the intestinal epithelium by circumventing the various host barrier functions. In the present study, we investigate how the bacterial pathogens such as *Shigella* colonize the intestinal epithelium and how they can evade host innate defense system. In brief, we focus on the role of subset of effectors secreted via the type III secretion system from intracellular *Shigella* in the middle of stage of infection of intestinal epithelium, and investigate their biological activities and roles of each of the effectors in promoting bacterial survival and colonization. Based on the results with each of the effectors together, we envisage to unveil the novel bacterial infectious system, which will also provide some important insight into understanding the sophisticated bacterial infectious strategies shared with many other bacterial pathogens.

【Expected results】

When we will achieve the goals of the research proposal, we expect the following outcomes; (i) our study will provide clue and idea to elucidate other bacterial infectious systems and the host-cellular responses, (ii) our study will allow us to evaluate the impact of each barrier function lying in the intestinal epithelium on bacterial infection, (iii) we will get some insight into understanding the molecular basis for determining the human-specificity of *Shigella*, and (iv) we will translate the knowledge obtained through this study into development of safer *Shigella* vaccine, and animal model.

【References by the principal researcher】

・Ogawa, M., Handa, Y., Ashida, H., Suzuki, M., and Sasakawa, C. The versatility of *Shigella* effectors. ***Nat. Rev. Microbiol***. 6, 11-16. 2008.
・Iwai H., Kim, M., Ashida H., Ogawa M., Fujita Y., et al. A bacteiral effector targets Mad2L2, an APC inhibitor, to modulate host cell cycling. ***Cell***. 130: 611-623. 2007.
・Yoshida S., Handa Y., Suzuki, T., Ogawa M., Suzuki M., et al. Microtubule-severing activity of *Shigella* is pivotal for intercellular spreading. ***Science***. 314: 985-989. 2006.
・Ogawa, M., Yoshimori, T., Suzuki, T., Sagara, H., Mizushima, N., et al. Escape of intracellular *Shigella* from autophagy. ***Science***. 307: 727-731. 2005.

【Term of project】 FY2008－2012	【Budget allocation】 **152,800,000 yen** (direct cost)

【Homepage address】 http://www.ims.u-tokyo.ac.jp/bac/hp/mainpage.html

Roles of guidance factors in immune regulation

Hitoshi Kikutani
(Osaka Universtiy, Research Institute for Microbial Diseases, Professor)

【Outline of survey】

Semaphorins, which were originally identified as axon guidance factors, play critical roles in development of not only the nervous system but also of other organ systems. Recent studies from the principal investigator's laboratory have also revealed that several semaphorins and their receptors are critically involved in regulation of immune responses. This study will be carried out in order to determine the mechanisms how semaphorins regulate immune responses, by 1) analyzing immune responses of gene targeted mice that are deficient in semaphorins or their receptors, 2) analyzing signals of semaphorins in immune cells and 3) analyzing effects of recombinant semaphorins or antibodies against semaphorins on various experimental animal models of immunological diseases.

【Expected results】

It is likely that semaphorins play roles in regulation of immune responses in the ways quite different from those used by known immunoregulatory molecules such as cytokines and co-stimulatory molecules, this study may reveal a novel mechanism of immune regulation. In addition, this study is expected to reveal new therapeutic molecular targets of various immunological disorders.

【References by the principal investigator】

- Suzuki, K., A. Kumanogoh, and H. Kikutani. Semaphorins and their receptors in immune cell interactions. Nat. Immunol., 9:17-23, 2008.
- Suzuki, K., T. Okuno, M. Yamamoto, R.J. Pasterkamp, N. Takegahara, H. Takamatsu, T. Kitao, J. Takagi, P.D. Rennert, A.L. Kolodkin, A. Kumanogoh, and H. Kikutani. Semaphorin 7A initiates T cell-mediated inflammatory responses through α1β1 integrin. Nature, 446:680-684, 2007.

【Term of project】 FY2008－2012	【Budget allocation】 159,300,000 yen (direct cost)

【Homepage address】 http://www.biken.osaka-u.ac.jp/

An integrative elucidation of the energy metabolism-regulating system and its disruption

Takashi Kadowaki

(The University of Tokyo, University Hospital, Professor)

【Outline of survey】

Glycemic, lipid and energy metabolism represents a critically important process in life's manifestations, where insulin (Ins) and adiponectin (Ad) account for two major pathways for this metabolic process. An integrative conceptualization of the energy metabolism-regulating system and its disruption will hold the key to unraveling the causes of diabetes and the metabolic syndrome (MS) as well as to developing therapeutic modalities for these conditions. The proposed research therefore intends to draw fully on the resources of tissue-specific Ad receptor (AdipoR)-deficient mice for elucidation of the action of Ad in relevant tissues (**Nature** 2003;423:762, **Nat Med** 2006;3:247) as well as on tissue-specific Ins receptor substrate (IRS)-deficient mice for evaluating the effect of primary depletion of Ins action on relevant tissues (**Nature** 1994;372:72, **J Clin Invest** 2004;114:917) to set out to (1) elucidate the mechanisms of interorgan cross-talk in metabolic regulation; and (2) to unravel the mechanisms of cellular function and homeostasis in place in metabolic regulation, thus aiming to give a full picture of the action of Ins and Ad in central and peripheral tissues as well as in the whole body.

【Expected results】

Ours is the only laboratory in the world to have access to and draw on the resources of tissue-specific Ad receptor (AdipoR)-deficient mice for elucidation of the action of Ad in relevant tissues (**Nature** 2003;423:762, **Nat Med** 2006;3:247) as well as on tissue-specific Ins receptor substrate (IRS)-deficient mice for evaluating the effect of primary depletion of Ins action on relevant tissues (**Nature** 1994;372:72, , **J Clin Invest** 2004;114:917) and thus is capable of integrative elucidation of the energy metabolism-regulating system. The proposed research is therefore expected to mark a milestone in that all resulting findings and insights will translate into novel therapeutic modalities for diabetes, the metabolic syndrome and associated cardiovascular disease.

【References by the principal researcher】

・Yamauchi T, Nio Y, Maki T, Kobayashi M, Takazawa T, Iwabu M, Okada-Iwabu M, Kawamoto S, Kubota N, Kubota T, Ito Y, Kamon J, Tsuchida A, Kumagai K, Kozono H, Hada Y, Ogata H, Tokuyama K, Tsunoda M, Ide T, Murakami K, Awazawa M, Takamoto I, Froguel P, Hara K, Tobe K, Nagai R, Ueki K, ＊Kadowaki T: Targeted disruption of AdipoR1 and AdipoR2 causes abrogation of adiponectin binding and metabolic actions. ***Nature Medicine*** 13: 332-339, 2007

・Kubota N, Yano W, Kubota T, Yamauchi T, Itoh S, Kumagai H, Kozono H, Takamoto I, Okamoto S, Shiuchi T, Suzuki R, Satoh H, Tsuchida A, Moroi M, Sugi K, Noda T, Ebinuma H, Ueda Y, Kondo T, Araki E, Ezaki O, Nagai R, Tobe K, Terauchi Y, Ueki K, Minokoshi Y, ＊Kadowaki T: Adiponectin stimulates AMP-activated protein kinase in the hypothalamus and increases food intake. ***Cell Metabolism*** 6: 55-68, 2007

【Term of project】 FY2008− 2012	【Budget allocation】 **174,800,000 yen** (direct cost)

【Homepage address】 None

Development of an innovative radiotherapy technologies for the improvement of treatment outcomes of intractable cancers.

Masahiro Hiraoka

(Kyoto University, Graduate School of Medicine, Professor)

【Outline of survey】

Lung Cancer, malignant pleural mesothelioma (MPM), esophageal cancer and pancreatic cancer are still formidable diseases to treat despite intensive efforts. Better control of local disease progression using radiation therapy is necessary to improve the prognoses for those patients. However, respiratory motion of these tumors and the adjacent risk organs make it difficult to focus the optimal radiation dose to the targets with accuracy and safety by conventional radiation techniques. To overcome these problems, we developed a novel irradiation system (TM series) in collaboration with the company; Mitsubishi Heavy Industries Ltd., which has the potential to track moving tumors continuously depending on respiratory motion. This system has some characteristic structures not only to have the ability to construct a tumor tracking system, but also have the potential to create the innovative irradiation techniques which has never been recognized.
In this project, we are going to develop a 4-dimensional (4D) system for radiotherapy, which responds to respiratory motion of each tumor of the individual patient, and to lead the established 3D-systems to the next 4D generation.

【Expected results】

The accomplishment expected in this project is to establish the methods of planning for radiation therapy which allow for the organ motion and deformation during breathing and to construct the methods how to evaluate them. In addition, by developing the novel irradiation systems maximizing the abilities of TM series, it is expected that the prominent progression from 3D to 4D generation in treatment planning and radiotherapy will be achieved, which would lead to innovative treatment strategies in radiation therapy.

.

【References by the principal investigator】

- Hiraoka M, Ishikura S.: A JCOG Trial for SBRT of NSCLC J Thoracic Oncol.,(In Press)
- Zhu S, Mizowaki T, Norihisa Y, Takayama K, Nagata Y, Hiraoka M.: Comparisons of the impact of systematic uncertainties on doses to the target among different plans of definitive external-beam radiotherapy for prostate cancer. Int J Clin Oncol, 2008 ;13(1):54-61
- Matsuo Y., Takayama K., Nagata Y., Kunieda E., Tateoka K., Ishizuka N., Mizowaki T., Norihisa Y., Sakamoto M., Narita Y., Ishikura S., Hiraoka M.: Interinstitutional variations in planning for stereotactic body radiation therapy for lung cancer. Int J Radiat Oncol Biol Phys, 2007 68(2):416-25
- Kamino Y, Takayama K, Kokubo M, Narita Y, Hirai E, Kawawda N, Mizowaki T, Nagata Y, Nishidai T, Hiraoka M.: Development of a four-dimensional image-guided radiotherapy system with a gimbaled X-ray head. Int J Radiat Oncol Biol Phys. 2006 ;66(1):271-8.
- Sawada A, Yoda K, Kokubo M, Kunieda T, Nagata Y, Hiraoka M.: A technique for noninvasive respiratory gated radiation treatment system based on a real time 3D ultrasound image correlation: a phantom study. Med Phys. 2004 Feb;31(2):245-50.

【Term of project】 FY2008－2012	【Budget allocation】 159,100,000 yen (direct cost)

【Homepage address】

http://www.kuhp.kyoto-u.ac.jp/%7Erad_onc/Public/department_info/mission.htm

Integrative Study of transcriptional network systems during enchondral ossification

Toshiyuki Yoneda

(Osaka University, Graduate School of Dentistry , Professor)

【Outline of survey】

In vertebrae, most of skeletons are formed by enchondral ossification. Endochondral ossification is a sequential and complex biological event that consists of condensation of mesenchymal cells, their differentiation into chondrocytes, maturation and apoptosis of chondrocytes, and replacement of cartilage tissue by bone. Transcription factors, Sox9 and Ruxn2 play an essential role in enchondral ossification and regulate the expression of genes necessary for chondrogenesis by cross-talking with numerous intracellular signalings. In this study, using molecular and cellular approaches and genetically engineered mice, we aim to understand transcriptional regulation and the network system spatially and temporally during enchondral ossification. Especially, we investigate the transcriptional factory which is a large protein complex assembled by Sox9 or Runx2. Thus, this study not only contributes to understanding of enchondral ossification but also makes breakthrough of the biology.

【Expected results】

We would understand transcriptional network system, mainly of Sox9 and Runx2, at molecular, cellular and animal levels, thus spatially and temporally regulatory mechanisms of enchondral ossification. Moreover, our findings might contribute to development of novel and effective treatment for cartilage diseases such as osteoarthritis and rheumatoid arthritis. Therefore, our study would be important for not only advancement of science but also clinical fields.

【References by the principal investigator】

1. Muramatsu S, Wakabayashi M, Ohno T, Amano K, Ooishi K, Sugahara T, Shiojiri S, Tashiro K, Suzuki Y, Nishimura R, Kuhara S, Sugano S, Yoneda T, Matsuda A (2007) Functional gene screening system identified TRPV4 as a regulator of chondrogenic differentiation ***J Biol Chem*** 282: 32158-67
2. Yoneda T (eds): (2008) Cutting-Edge of Biodentistry (Osaka University Press)

【Term of project】 FY2008－2010	【Budget allocation】 164,100,000 yen (direct cost)

【Homepage address】 http://www.dent.osaka-u.ac.jp/~biochm/

List of the Continuing Projects for Grant-in-Aid for Scientific Research (S) of KAKENHI

Integrated Science and Innovative Science （66 Projects）

○ Comprehensive fields（31 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Shinji Tomita	Kyoto University/Graduate School of Informatics/Professor	Real-Time Sensable Simulation Systems	FY2004-2008	84,900
Masayuki Inaba	The University of Tokyo/Graduate School of Information Science and Technology/Professor	Development of Generative Human-Interaction in Life-Size HumanoidIntegrating Robot Intelligence Kernels	FY2004-2008	83,200
Tsutomu Nakada	Niigata University/Brain Research Institute/Professor	High-resolution Clinical Imaging on 7.0T MR system	FY2004-2008	85,100
Yasunobu Handa	Tohoku University/Graduate School of Medicine/Professor	Development of an injectable microstimulator system for neuromodulatory electrical stimulation and functional electrical stimulation	FY2004-2008	68,000
Toshiro Inubushi	Shiga University of Medical Science/Molecular Neuroscience Research Center/Professor	Non-invasive MRI tracking of labeled stem cells and its application to regenerative medicine	FY2004-2008	86,100
Masaru Zako	Osaka University/Graduate School of Engineering/Professor	Design system for an artificial arthrosis with CT scanning and development of a femoral stem made of fabric composites	FY2004-2008	82,400
Yasushi Yagi	Osaka University/The Institute of Scientific and Industrial Research/Professor	Wearable omnidirectional stereo surveillance system	FY2005-2009	76,500
Norihiro Sadato	National Institute for Physiological Sciences/Division of Cerebral Integration/Professor	Elucidation of the process by which social skills develop using noninvasive functional neuroimaging to quantitate multiple individual interactions and analyse their neural bases	FY2005-2009	80,800
Masanobu Kano	Osaka University/Graduate School of Medicine/Professor	Elucidation of mechanisms and physiological meanings of endocannabinoid-mediated retrograde modulation of synaptic transmission	FY2005-2009	81,200
Fujio Murakami	Kyusyu University/Faculty of Engineering/Professor	Role of cortical interneuron migration for establishment of area specificity of the cortex	FY2005-2009	80,600
Shoogo Ueno	The University of Tokyo/Graduate School of Medicine/Professor	Magnetic approaches to bioimaging and functional brain dynamics	FY2005-2009	81,400
Sonshin Takao	Kagoshima University/Frontier Science Research Center/Professor	Basic Research of Xenotransplantation	FY2005-2009	78,400
Takeyoshi Dohi	The University of Tokyo/Graduate School of Information Science and Technology /Professor	Development of Next Generation End Effecter and Navigation System for Computer Aided Surgery	FY2005-2009	69,600
Tohru Ifukube	The University of Tokyo/Research Center for Advanced Science and Technology/Professor	Practical Research of a Model for Industrializing Barrier-free Apparatus and Effects of Disabled Persons' Participation into Society by use of Assistive Technology for Communication Disorders	FY2005-2008	65,500
Yuji Oie	Kyushu Institute of Technology/Faculty of Computer Science & Systems Engineering/Professor	Research on Fusion Technology and Information Dynamics for Penetrative and Evolutional Network	FY2006-2010	80,500

Principal Investigator		Title	Term of project	Total (Thousand yen)
Keiji Kawachi	The University of Tokyo/Graduate School of Engineering/Professor	Control Mechanism of Insect Flight	FY2006-2010	76,400
Toshiya Manabe	The University of Tokyo/Institute of Medical Science/Professor	Molecular basis for emotion and its role in higher brain functions and psychiatric and neurological disorders	FY2006-2010	84,200
Kensaku Mori	The University of Tokyo/Graduate School of Medicine/Professor	Behavioral state-dependent change in the information processing modes in the central olfactory system	FY2006-2010	83,200
Mamoru Ito	Central Institute for Experimental Animals/Immune Lab/Head	Basic study to establish a "humanized animal model" by improvement and modification of severely immunodeficient NOG mice	FY2006-2010	76,900
Kenji Sunagawa	Kyushu University/Graduate School of Medical Sciences/Professor	Exploration into the Development of Bionic Blood Pressure Controller in Patients with Spinal Cord Injuries	FY2006-2010	84,700
Yoshinori Yasuda	International Research Center for Japanese Studies/Research Department/Professor	Environmental annual history and rise and fall of the rice-cultivating and fishing civilization by the study of annually laminated sediments	FY2006-2010	84,900
Toyoaki Nishida	Kyoto University/Graduate School of Informatics/Professor	Studies on Construction and Utilization of a Common Platformfor Embodied Conversational Agent Research	FY2007-2011	89,500
Masatoshi Ishikawa	The University of Tokyo/Graduate School of Information Science and Technology/Professor	Applications of Vision Chip	FY2007-2011	85,200
Hiroshi Okuno	Kyoto University/Graduate School of Informatics/Professor	Development of Robot Audition from Computational Auditory Scene Analysis	FY2007-2011	91,800
Toshikazu Kato	Chuo University/Faculty of Science and Engineering/Professor	Robotics modeling of diversity of multiple KANSEI and situation understanding in real space	FY2007-2011	62,000
Masahiko Watanabe	Hokkaido University/Graduate School of Medicine/Professor	Molecular mechanisms for calcium-mediated refinement of competitive synaptic wiring in the brain	FY2007-2011	89,900
Takeshi Yagi	Osaka University/Graduate School of Frontier Biosciences/Professor	Molecular mechanism for neuronal diversity and organization in the brain	FY2007-2011	87,300
Junichi Hayashi	University of Tsukuba/Graduate School of Life and Environmental Sciences/Professor	Analysis of entire physiological roles of mammalian mtDNA by generation of mice carrying various pathogenic mutations	FY2007-2011	85,100
Takami Yamaguchi	Tohoku University/Graduate School of Engineering/Professor	Computational Nanobiomechanics for the diagnosis, treatment, andprevention of diseases of blood, circulatory, and digestive organs	FY2007-2011	90,100
Yoshinobu Ohira	Osaka University/Graduate School of Medicine/Professor	Promotion of muscle activities as the countermeasure for prevention of the deterioration of brain function	FY2007-2011	89,500
Sakuji Yoshimura	Waseda University/Faculty of Science and Engineering/Professor	THE MEMPHITE NECROPOLIS, EGYPT SITE MANAGEMENT PLAN PROJECT	FY2007-2011	82,200

○ New multidisciplinary fields（35 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Mitsuo Fukuchi	National Institute of Polar Research/Sub Head	Studies on the biological processes in the Antarctic Ocean and the global climate changes	FY2004–2008	76,900
Masami Watanabe	Kyoto University/Research Reactor Institute/Professor	X-ray-induced long-lived radicals causing mutation and carcinogenesis	FY2004–2008	77,900
Keisaku Kimura	Hyogo University/Graduate School of Science/Professor	Through Quantum Dot to Quantum Crystal: Creation and Development of 2D, 3D Nanoparticle Crystal	FY2004–2008	85,100
Hiroyuki Fujita	The University of Tokyo/Institute of Industrial Science/Professor	Nano Hand-Eye System for Simultaneous Imaging and Characterization of Nano Objects	FY2004–2008	87,700
Akira Inoue	Okayama University/Graduate School of Natural Science and Technology/Professor	Construction of an Advanced Integrated Control Structure for Safety and Functional Maintenance in Disaster-Stricken Industrial Complex	FY2004–2008	85,800
Hiroaki Suga	The University of Tokyo/Research Center for Advanced Science and Technology/Professor	Generation of ribozymes that catalyze fatty acid biosynthesis and toward RNA-based life	FY2004–2008	86,200
Taizo Hogetsu	The University of Tokyo/Graduate School of Agricultural and Life Sciences/Professor	Exhaustive molecular genetic analysis of trees and ectomycorrhizal fungi and establishment of their molecular ecology database	FY2004–2008	80,500
Yuji Sano	The University of Tokyo/Ocean Research Institute/Professor	Study on ocean circulation in the Pacific using noble gas tracers	FY2005–2009	82,200
Toru Shimizu	Tohoku University/Institute for Multidisciplinary Research for Advanced Materials/Professor	Impairment of the biological clock system by environmental chemicals: Cross talk between heme, NO, translation and clock gene	FY2005–2009	85,500
Seizo Morita	Osaka University/Graduate School of Engineering/Professor	Mechanism and conditions on the atomic-interchange lateral manipulation	FY2005–2009	84,500
Masaharu Oshima	The University of Tokyo/Graduate School of Engineering/Professor	Development of nano-spectroscopy using synchrotron radiation photoelectron emission microscope	FY2005–2009	84,500
Yukichi Umakoshi	Osaka University/Graduate School of Engineering/Professor	Development of new evaluation method for diseased, defected and regenerated bone and its clinical application	FY2005–2008	78,200
Akira Asada	The University of Tokyo/Institute of Industrial Science/Professor	Development of unmanned seafloor geodetic observation system based on technologies of underwater robotics and seafloor platform	FY2005–2009	84,100
Makoto Kiso	Gifu University/Faulty of Applied Biological Sciences/Professor	Design and synthesis of functional bio-probes based on complex carbohydrates, and their application for bio-medical use	FY2005–2009	69,800
Mamoru Shibayama	Kyoto University/Center for Southeast Asian Studies/Professor	Development of Area Informatics -In Focusing on Southeast Asian Region-	FY2005–2009	90,300
Ryuji Tada	The University of Tokyo/Graduate School of Science/Professor	Paleoceanography for future prediction: Possibility of climatic mode jump in response to global warming	FY2006–2010	84,000
Kenshi Komatsu	Kyoto University/Radiation Biology Center/Professor	Induction of DNA double strand break by environmental genotoxic and carcinogenic agents	FY2006–2010	83,600

Principal Investigator		Title	Term of project	Total (Thousand yen)
Tomonari Matsuda	Kyoto University/Global Environmental Studies/Associate Professor	Identification of new DNA damages by DNA adductome analysis	FY2006-2010	74,800
Toyohiko Kinoshita	Japan Synchrotron Radiation Research Institute/Spectroscopy Group II/Chief Scientist, Group leader	Observation of high-speed magnetic dynamics by time-resolved photoemission electron microscopy	FY2006-2010	84,500
Tomokazu Iyoda	Tokyo Institute of Technology/Chemical Resources Laboratory/Professor	Simultaneous Dynamic Measurement of Transcription and formation processes of Ultra-anisotropic Cylinder Nanostructures	FY2006-2010	84,500
Tomokazu Matsue	Tohoku University/Graduate School of Environmental Studies/Professor	Multifunctional Nano-Scanning Electrochemical Microscopy System	FY2006-2010	83,700
Katsuhiko Shirahige	Tokyo Institute of Technology/Center for Biological Resources and Informatics/Associate Professor	A Novel Genomic Approach for the Understanding of the Structure and Function of Chromosomes	FY2006-2010	79,600
Koichi Kawakami	National Institute of Genetics/Department of Developmental Genetics/Associate Professor	Studies on vertebrate development by the transposon-mediated Gal4 enhancer trap method in zebrafish	FY2006-2010	79,200
Youji Sakagami	Nagoya University/Graduate School of Bioagricultural Sciences/Professor	Studies of Bioorganicchemistry on Microbial and Plant Peptide Factors	FY2006-2010	82,700
Michio Murata	Osaka University/Graduate School of Science/Professor	Structures and Functions of Membrane-bound Biomolecules	FY2006-2010	85,100
Yutaka Kondo	The University of Tokyo/Research Center for Advanced Science and Technology/Professor	Studies on impacts of black carbon aerosol based on aircraft observations	FY2007-2011	85,100
Takeshi Todo	Osaka University/Graduate School of Medicine/Professor	Screening for Induced Point Mutations in Medaka with TILLING	FY2007-2011	82,800
Akira Naganuma	Tohoku University/Graduate School of Pharmaceutical Sciences/Professor	Cellular Systems Involved in Development and Regulation of Toxicity of Methylmercury	FY2007-2011	84,400
Kunio Takayanagi	Tokyo Institute of Technology/Graduate School of Science and Engineering/Professor	Angle Resolved Spectroscopic Observation of Electron Beam induced Radiation from Nano-Structures excited by Low-Energy Electron Nanoprobe	FY2007-2011	80,900
Masayoshi Esashi	Tohoku University/Graduate School of Engineering/Professor	Study of massive parallel direct electron beam delineation systems	FY2007-2011	84,800
Koji Ishibashi	RIKEN/Advanced Device Laboratory/Chief Researcher	Study on interaction between carbon nanotube quantum dots and electromagnetic wave	FY2007-2011	72,600
Yoshiaki Kawata	Kyoto University/Disaster Prevention Research Institute/Professor	Catastrophic Compound Disasters and Their Disaster Reduction Strategy	FY2007-2011	72,800
Hidetoshi Inoko	Tokai University/School of Medicine/Professor	Genome-wide identification of genes for anorexia and their cascade analysis on disease development by functional study	FY2007-2011	84,300
Junji Takabayashi	Kyoto University/Center for Ecological Research/Professor	Induced indirect defense of plants against herbivores and its application in pest control	FY2007-2011	84,600
Mitsuaki Nishibuchi	Kyoto University/Center for Southeast Asian Studies/Professor	Infectious diseases spreading across international borders in Southeast Asia: elucidation of area-specific features based on multifactorial analysis	FY2007-2011	83,600

Humanities and Social Sciences （19 Projects）

○ Humanities（10 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Yasuhiko Nagano	National Museum of Ethnology/Research Strategy Center/Professor	Linguistic Substratum in Tibet Synchronic survey of undescribed Tibeto-Burman languages and reconstruction of Zhangzhung language	FY2004-2008	69,100
Tatsuhiko Seo	Chuo University/Faculty of Literature/Professor	The Urban Environmental Management in the East Asia from the Point of Historical Analysis	FY2004-2008	82,600
Hideo Kuroda	Rissho University/Faculty of Letters/Professor	High-Minute-Digital-Image Processing of Genre Pictures of the Medieval and Modern Period and Research on Historical Records of Paintings	FY2005-2009	76,800
Takeru Akazawa	Kochi University of Technology/Research Institute/Professor	Comprehensive Clarification of the Transition from Neanderthals to Modern Humans in the Dead Sea Rift Valley of West Asia	FY2005-2009	79,500
Tetsuo Nishio	National Museum of Ethnology/Center for Research Development/Professor	Studies on the history of the Arabian Nights and its influence upon the literary genesis of Orientalism	FY2006-2010	61,800
Nobuyuki Yoshida	The University of Tokyo/Graduate School of Humanities and Sociology/Professor	Comparative Studies of the Segmental Socio-Spatial Structures in Traditional Cities, 1500-1900	FY2006-2010	82,600
Itaru Tomiya	Kyoto university/Institute for research in Humanities/Professor	Ceremony and Punishment in East Asia－inter-disciplinary research of ritual order and legal order	FY2006-2010	64,800
Yoshifumi Ikeda	University of the Ryukyus/Faculty of Law and Letters/Professor	Grasping and Analyzing Mongolian-Expedition-Related Archeological Sites and Remains on the Seabed of Takashima(Kitamatsuura-county, Nagasaki Prefecture, Japan)	FY2006-2010	80,000
Hiromitsu Ogawa	The University of Tokyo/The Institute of Oriental Culture/Professor	Research on Pursuit and Formation of Cultural and National Identity Constructed in Figurative Arts—from the Entire Region of Asia to the Whole World	FY2007-2011	82,200
Ichiro Touyama	Aichi Prefectural University/Faculty of Letters/Professor	Study of Literature and Culture Related With War Affairs	FY2007-2011	62,500

○ Social sciences（9 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Hirofumi Uzawa	Doshisha University/Research Center of Social Common Capital/Director	Theoretical, Institutional, and Historical Studies of Social Common Capital	FY2004-2008	56,700
Ko Hasegawa	Hokkaido University/School of Law/ Professor	A Study on the Creole and the Agency Formation of Law	FY2005-2009	50,700
Kazuo Yoshida	Kyoto University/Graduate School of Economics/Professor	Simulation Analysis of Global Orders based on the Concept of Global Public Goods	FY2005-2009	89,900
Kazumi Asako	Hitotsubashi University/Institute of Economic Research/Professor	Synthetic Studies on Business Cycle and Economic Growth-Construction of Business Cycle Models and Empirical Analyses of Japanese Economy	FY2006-2010	83,400

Principal Investigator		Title	Term of project	Total (Thousand yen)
Hitoshi Hirakawa	Nagoya University/Graduate School of Economics/Professor	Studies on Industrial Agglomeration and Corporate Linkage in East Asia and Symbiotic Sustainability	FY2006-2010	89,200
Hiroshi Ishida	The University of Tokyo/Institute of Social Sciences/Professor	Comprehensive Study of Behavior and Attitudes among Youth in Contemporary Japan	FY2006-2010	85,900
Jiro Yamaguti	Hokkaido University/Graduate School of Public Policy/Professor	Comprehensive research on ideas and policy of civil social democracy	FY2007-2011	75,800
Makoto Yano	Kyoto University/Institute of Economic Research/Professor	Globalization and the Japanese Economy- People, Goods, Money, and Social Overhead Capital -	FY2007-2011	60,000
Yoshitaka Nakajima	Kyushu University/Graduate School of DESIGN/Professor	Temporal continuity and phonological discontinuity in linguistic communication:Collaboration between perceptual psychology, linguistics, and speech science	FY2007-2011	51,400

Science and Engineering （114 Projects）

○ Mathematical and physical sciences（36 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Masahisa Tabata	Kyushu University/Faculty of Mathematics/Professor	Development and analysis of high-quality numerical methods and simulation for flow problems	FY2004-2008	60,800
Tohru Ozawa	Hokkaido University/Graduate School of Science/Professor	Geometry and Analysis for Classical Fields	FY2004-2008	66,700
Shik Shin	The University of Tokyo/Institute for solid state physics/Professor	Study on the electronic structure of biomaterials using a high efficiency soft x-ray emission spectrometer	FY2004-2008	73,100
Youichi Murakami	Tohoku University/Graduate School of Science/Professor	The study on ordering and fluctuation of electronic degrees of freedom by coherent x-rays and high-flux neutrons	FY2004-2008	80,300
Nobuhiko Azuma	Nagaoka University of Technology/Department of Mechanical Engineering/Professor	Investigation of micro-physical and chemical processes in polar ice sheet using high-resolution laser techniques	FY2004-2008	83,100
Hiroko Nagahara	The University of Tokyo/Graduate School of Sciences/Professor	Experimental study on the relationship between evolution of stars and silicate dusts	FY2004-2008	81,300
Junjiro Noguchi	The University of Tokyo/Graduate School of Mathematical Sciences/Professor	Integrated Research of Analytic and Geometric Invariants of Complex Structure	FY2005-2009	75,200
Yuzuru Yoshii	The University of Tokyo/Graduate School of Science/Professor	Study of the Large-Scale Structure of Ionized Gas and the Star-Gas Cosmic Cycle in our Galaxy	FY2005-2009	76,100
Tadafumi Kishimoto	Osaka University/Graduate School of Science/Professor	Study of Double Beta Decay of 48Ca	FY2005-2009	84,300
Toshirou Yagi	Hokkaido University/Professors emeritus	Study of Coherent Quantum Fluctuation Competed with the Long-Ranged Ferroelectric Ordering	FY2005-2009	76,300

Principal Investigator		Title	Term of project	Total (Thousand yen)
Yoshichika Otani	The University of Tokyo/Institute for Solid State Physics/Professor	Development of the rectifying device for spin dynamics using asymmetric potential	FY2005-2009	61,600
Akira Kouchi	Hokkaido University/Institute of Low Temperature Science/Professor	Evaluation of catalytic effect of amorphous ice on the surface atomic reactions	FY2005-2009	79,400
Kenji Fukaya	Kyoto University/Graduate school of Science/Professor	Developments of Geometry by topological Field theory	FY2006-2010	63,200
Masayasu Mimura	Meiji University/School of Science and Technology/Professor	Mathematical Theory of Nonlinear-Non-equilibrium Reaction-Diffusion Systems	FY2006-2010	54,200
Masayuki Fujimoto	Hokkaido University/Graduate School of Science/Professor	A Study on the First Stars in our Universe as a Probe into its Early History	FY2006-2010	78,800
Kazuo Makishima	The University of Tokyo/Graduate School of Science/Professor	Investigation of Interactions between Galaxies and Inter-Galactic Plasmas	FY2006-2010	79,000
Akira Ukawa	University of Tsukuba/Graduate School of Pure and Applied Sciences/Professor	Computational particle physics with massively parallel cluster PACS-CS	FY2006-2010	70,600
Akira Yamamoto	High Energy Accelerator Research Organization/Cryogenics Science Center/Professor	Search for Cosmic-ray Antiparticle of Cosmic Origin in Solar Minimum Period by using a Superconducting Magnetic Spectrometer	FY2006-2009	80,200
Shigemasa Suga	Osaka University/Graduate School of Engineering Science/Professor	Studies of metal to insulator transition by bulk sensitive photoelectron spectroscopy	FY2006-2008	52,800
Yutaka Ueda	The University of Tokyo/Institute for Solid State Physics/Professor	The study of novel quantum phenomena caused from the competition among multiple ground states in vanadium oxides	FY2006-2010	72,500
Eiji Ohtani	Tohoku University/Faculty of Science/Professor	Composition and evolution of the Earth's core	FY2006-2010	80,800
Junichi Matsuda	Osaka University/Graduate School of Science/Professor	The origin of the major carrie of noble gases in meteorites and its cosmo-geochemical implications	FY2006-2010	76,000
Rikizo Hatakeyama	Tohoku University/Graduate School of Engineering/Professor	Exploitation of Untrodden Field of Carbon-Based Nano-Bio Research Using Innovative Plasma Technology	FY2006-2010	83,900
Toshiyuki Katsura	The University of Tokyo/Graduate School of Mathematical Sciences/Professor	Study on Algebraic Varieties related to moduli spaces and algebraic cycles	FY2007-2011	70,900
Masahiko Saito	Kobe University/Graduate School of Science/Professor	New Developments and Interaction between Algebraic Geometry and Integrable Systems	FY2007-2011	76,300
Hideyo Kunieda	Nagoya University/Graduate school of Science/Professor	Balloon borne hard X-ray imaging observations of active galactic nuclei and cluster of galaxies	FY2007-2011	81,500
Masanori Iye	National Astronomical Observatory/Optical and Infrared Astronomy Division/Professor	Unraveling galaxy formation history using laser guide star adaptive optics system	FY2007-2011	100,400
Takaaki Kajita	The University of Tokyo/Institute for Cosmic Ray Research/Professor	High sensitivity search for $\nu\ \mu$ to ν e oscillations	FY2007-2011	79,400

Principal Investigator		Title	Term of project	Total (Thousand yen)
Katsuhiko Sato	The University of Tokyo/Graduate School of Science/Professor	Quest for the unified picture of the explosion mechanism of supernovae and the central engine of gamma-ray bursts	FY2007-2011	66,800
Seigo Tarucha	The University of Tokyo/Graduate School of Engineering/professor	Detection and manipulation of quantum coherence in quantum dots and wires	FY2007-2011	77,200
Hidenori Takagi	The University of Tokyo/Graduate School of Frontier Sciences/professor	Electric Field Induced Phase Changes in Transition Metal Oxides	FY2007-2011	84,800
Katsuya Shimizu	Osaka University/Center for Quantum Science and Technology under Extreme Conditions/Professor	Superconductivity in elements under very high pressure	FY2007-2011	97,100
Toshiyuki Azuma	Tokyo Metropolitan University/Graduate School of Science and Engineering/Professor	Atomic physics with resonant coherent excitation by crystal field	FY2007-2011	83,600
Hitoshi Kawakatsu	The University of Tokyo/The Earthquake Research Institute/Professor	NECESSArray Project - Earth dynamics viewed from the Chinese continent	FY2007-2011	97,600
Akira Tsuchiyama	Osaka University/Graduate School of Science/Professor	Importance of amorphous silicates as source material of the solid planets and its initial evolution	FY2007-2011	81,600

○ Chemistry（22 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Mitsuhiko Shionoya	The University of Tokyo/Graduate School of Science/Professor	Programming Spatial Arrangements and Specific Dynamic Functions of MetalComplexes using Artificial Ligands with Multi-Binding Sites	FY2004-2008	89,200
Hitoshi Watarai	Osaka University/Graduate School of Science/Professor	Development of Measurement Methods and Analytical Reactions in Nanochemistry at the Liquid-Liquid Interface	FY2004-2008	86,700
Hideo Takezoe	Tokyo Institute of Technology/Graduate School of Engineering/Professor	New Science and Functions in Liquid Crystals Formed from Bent-Core Molecules	FY2004-2008	84,200
Tomiki Ikeda	Tokyo Institute of Technology/Chemical Resources Laboratory/Professor	Creation of High-Performance Thin Holograms based on Polymer Liquid Crystals with Giant Change in Refractive Index	FY2004-2008	81,100
Yoshiyasu Matsumoto	Kyoto University/Graduate School of Sciences/Professor	Study on surface reaction mechanism by spatio-temporal mapping	FY2005-2009	81,800
Mikio Takano	Kyoto University/Institute for Chemical Research/Professor	Chemistry and Physics of 3d Transition Metal Oxides Equipped with Deep 3d Levels: Search for New Materials and New Functions	FY2005-2009	81,700
Yoshinori Naruta	Kyushu University/Institute for Materials Chemistry and Engineering/Professor	Synthesis of Molecular Catalysts for Interconversion of Water and Oxygen	FY2005-2009	79,700
Hirokazu Hasegawa	Kyoto University/Graduate School of Engineering/Associate Professor	Study of Lattice Defects and Grain Boundaries in Microphase-Separated Structures of Block Copolymers by Three-Dimensional Electron Tomography	FY2005-2009	79,700
Tetsuro Majima	Osaka University/The Institute of Scientific and Industrial Research/Professor	Nanoscience of photofunctional DNA	FY2005-2009	82,400

Principal Investigator		Title	Term of project	Total (Thousand yen)
Tokuji Miyashita	Tohoku University/Institute of Multidisciplinary Research for Advanced Materials/Professor	Fabrication of Polymer Nano-devices using Bottom-up Nanotechnology	FY2005-2009	79,000
Kazuo Takatsuka	The University of Tokyo/Graduate School of Arts and Sciences/Professor	Theory of Chemistry beyond the Born-Oppenheimer concept	FY2006-2010	85,400
Hiroharu Suzuki	Tokyo Institute of Technology/Graduate School of Science and Engineering/Professor	Reaction Chemistry of Transition metal Clusters	FY2006-2010	88,100
Eiichi Nakamura	The University of Tokyo/School of Science/Professor	Studies on Diversity and Synergy of Elements Directed toward Organic Synthesis	FY2006-2010	86,300
Shinzaburo Ito	Kyoto University/Graduate School of Engineering/Professor	New developments in polymer science through polymer chain imaging:empirical foundation research using scanning near-field optical microscopy	FY2006-2010	91,400
Kazuhiko Nakatani	Osaka University/The Institute of Scientific and Industrial Research/Professor	Functional Control by Modulating the Nucleic Acid Structure Based on Mismatch Base Pair Stabilization	FY2006-2010	87,000
Tetsuo Asakura	Tokyo University of Agriculture and Technology/Institute of Symbiotic Science and Technology/Professor	Development of Techniques for Improvement of Silk Structure, Establishment of Mass Production, and Application to New Silk-based Materials for Bone and Teeth Regeneration	FY2006-2010	86,300
Akira Sekiguchi	University of Tsukuba/Graduate School of Pure and Applied Sciences/Professor	Research on the Low-Coordinate and Multiply-Bonded Compounds of Heavier Main Group Elements	FY2007-2011	85,900
Tamio Hayashi	Kyoto University/Graduate School of Science/Professor	Advanced Control of Catalytic Activity and Stereoselectivity in Catalytic Asymmetric Reactions	FY2007-2011	85,100
Hiroyuki Nishide	Waseda University/Faculty of Science and Engineering/Professor	SOMO Design of Radical Polymers for Development of Fully Organic Rechargeable Batteries	FY2007-2011	77,600
Yoshihito Watanabe	Nagoya University/Research Center for Materials Science/Professor	Molecular Design of Oxygenases Applicable to Synthetic Chemistry	FY2007-2011	85,500
Kaname Kanai	Nagoya University/Research Center for Materials Science/Assistant Professor	Structure and Electronic Structure of Organic Interfaces:From Well-defined Ideal Interfaces to Real Devices	FY2007-2011	79,300
Shoji Yamanaka	Hiroshima University/Graduate School of Engineering/Professor	Preparation and Characterization of New Exotic Superconductors Having Porous Networks	FY2007-2010	59,700

○ Engineering(56 Projects)

Principal Investigator		Title	Term of project	Total (Thousand yen)
Nobuhiko Sawaki	Nagoya University/Graduate School of Engineering/Professor	Formation of III-nitrides nano-heterostructures on patterned silicon substrate by selective epitaxy	FY2004-2008	89,200
Takayuki Kitamura	Kyoto University/Graduate School of Engineering/Professor	Interface Strength of Low-Dimensional Small Components	FY2004-2008	84,500
Hitoshi Okubo	Nagoya University/EcoTopia Science Institute/Professor	Feasibility Study on Introduction Effects of Superconducting Fault Current Limiting Transformer (SFCLT) into Electric Power System	FY2004-2008	83,800

Principal Investigator		Title	Term of project	Total (Thousand yen)
Ikuo Suemune	Hokkaido University/Research Institute for Electronic Science/Professor	Study on Coherent Control of Exciton States in Quantum Dots Embedded in Pyramidal Microcavities	FY2004–2008	84,700
Ayaho Miyamoto	Yamaguchi University/Faculty of Engineering/Professor	Strategic Life-Cycle Management for Civil Infrastructure Systems with the Latest Information Technologies	FY2004–2008	80,500
Yoshihiko Hirotsu	Osaka University/The Institute of Scientific and Industrial Research/Professor	Fabrication of Hard Magnetic Alloy Nanoparticles by Vapor-Deposition and Their Electron Diffraction Structure Analysis and Magnetic Property Measurements	FY2004–2008	84,800
Toyonobu Yoshida	The University of Tokyo/Graduate School of Engineering/Professor	Development of High-temperature cBN Thin Film Devices for Severe Environments	FY2004–2008	87,300
Kiyotaka Asakura	Hokkaido University/Catalysis Research Center/Professor	Development and in-situ structure analysis of novel metal phosphide hydrotreating catalysts	FY2004–2008	85,800
Izumi Kumagai	Tohoku University/Graduate School of Engineering/Professor	Protein Engineering for Construction of Bio-interfaces	FY2004–2008	86,200
Yoshihiro Arakawa	The University of Tokyo/School of Engineering/Professor	Reduction of Discharge Oscillations and High Density Plasma Ion Extraction on a Hall Thruster	FY2004–2008	85,100
Yuichi Takase	The University of Tokyo/Graduate School of Frontier Sciences/Professor	Production and Maintenance of High Beta Spherical Tokamak Plasmas using a New Method	FY2004–2008	83,600
Tetsuo Shoji	Tohoku University/School of Engineering/Professor	Research on Mechanics and Mechanisms of Stress Corrosion Cracking Based upon Mechano-Chemical Oxidation Kinetics	FY2005–2009	85,900
Yasutaka Nagano	Nagoya Institute of Technology/Executive Vice-President	Elementary Processes of Convective and Diffusive Transport in Urban Environment and Next-Generation Turbulence Modeling	FY2005–2008	80,800
Mitsuteru Inoue	Toyohashi University of Technology/School of Engineering/Professor	Fabrication of nano-structured magnetophotonic crystals with high spatial dimensions and their spin-dependent linear and non-linear optical functions	FY2005–2009	86,200
Hideo Kawanishi	Kogakuin University/Faculty of Engineering/Professor	Research on Deep-UV semiconductor Laser Lasing in 205–250 nm Region	FY2005–2009	66,500
Syunsuke Ikeda	Tokyo Institute of Technology/Graduate School of Science and Engineering/Professor	Movement of flow, sediment and nutrients in a watershed and the development of watershed management technique to reduce the impact on environment; targeting subtropical area	FY2005–2009	73,000
Kazuo Yamamoto	The University of Tokyo/Environmental Science Center/Professor	Development of next generation MBR for sustainable utilization of urban water resources	FY2005–2009	84,200
Masahiko Morinaga	Nagoya University/ Graduate School of Engineering/Professor	A unified understanding of the chemical bond in hydrogen storage materials by electron density distributions and its application to quantum materials design	FY2005–2009	89,500
Hideo Nakajima	Osaka University/The Institute of Scientific and Industrial Research/Professor	Fabrication of Novel Nano-hollow Sphere Metals and Metallic Nano-tube and Elucidation of Physical Properties	FY2005–2009	85,200
Muneyoshi Yamada	Tohoku University/Graduate School of Engineering/Professor	Catalyst Development for On-Site GTL Process Using Integrated Tool of In-Situ Surface Observation and HTS	FY2005–2009	82,000

Principal Investigator		Title	Term of project	Total (Thousand yen)
Teruo Fujii	The University of Tokyo/Institute of Industrial Science/Professor	Deep Sea Deployment of A Microfabricated In Situ Gene Analysis System and Its Functional Sophistication	FY2005-2009	70,200
Takaaki Fujita	Japan Atomic Energy Research Institute/Department of Fusion Plasma Research/Principal Scientist	Investigation on the edge structure of tokamak plasmas by edge current profile measurement with ultra-high spatial resolution	FY2005-2008	83,200
Seiichi Tagawa	Osaka University/The Institute of Scientific and Industrial Research/Professor	Elucidation of spatiotemporal reactions in nano-space by femtosecond pulse radiolysis	FY2005-2008	84,100
Yoshikazu Takeda	Nagoya University/Graduate School of Engineering/Professor	Intrinsic Hetero-interface Structures and Their Formation	FY2006-2010	89,400
Hiroshi Masuhara	Nara Institute of Science and Technology/Graduate School of Materials Science/Professor	Photon Pressure Chemistry of Crystallization and Molecular Arrangement Control in Crystals	FY2006-2010	85,800
Masumi Saka	Tohoku University/Graduate School of Engineering/Professor	Formation of Metallic Nanomaterials by Controlled Atomic Accumulation and their Characterizations	FY2006-2010	74,800
Toshio Miyauchi	Tokyo Institute of Technology/Graduate School of Science and Engineering/Professor	A Study on Turbulent Stratified/Multiphase Combustion by High Resolution Combined Laser Diagnostics and Large-Scale GIRD DNS	FY2006-2010	79,000
Mamoru Mitsuishi	The University of Tokyo/Graduate School of Engineering/Professor	A Medical CAD/CAM System for Minimally Invasive Surgery using a Compact Surgical Robot	FY2006-2010	87,500
Taiichi Otsuji	Tohoku University/Research Institute of Electrical Communication/Professor	Exploring Novel Electromagnetic Circuit Based on Management of Low-Dimensional Plasmonic Dispersion	FY2006-2010	86,700
Masaaki Tanaka	The University of Tokyo/Graduate School of Engineering/Professor	Reconfigurable Nano-spin Devices	FY2006-2010	77,900
Motoyuki Sato	Tohoku University/Center for Northeast Asian Studies/Professor	Radar technology for humanitarian demining and its application	FY2006-2010	86,100
Kiyoshi Toko	Kyushu University/Faculty of InformationScience and Electrical Engineering/Professor	Development of Kansei Biosensor	FY2006-2010	86,800
Chitoshi Miki	Tokyo Institute of Technology/Graduate School of Science and Engineering/Professor	Establishment of steel bridge resuscitative engineering to recover and improve the function of steel bridges with serious fatigue damage	FY2006-2010	73,300
Shojiro Ochiai	Kyoto University/International Innovation Center/Professor	Development of in-situ measurement method of internal strain and critical current of composite superconductors and their quantitative evaluation	FY2006-2009	84,800
Ryosuke Kainuma	Tohoku University/Multidisciplinary Research for Advanced Materials/Professor	Development of New Functional Alloys with Heusler-type Structure —Their Phase Stability and Physical Properties—	FY2006-2009	87,400
Yasuhiro Iwasawa	The University of Tokyo/Graduate School of Sciences/Professor	Study on developments of highly efficient selective oxidation and fuel cell oxidation catalysts and their real-time structure analyses	FY2006-2010	85,300
Nobuo Takeda	The University of Tokyo/Graduate School of Frontier Sciences/Professor	Optical fiber sensor monitoring system of composite structures for damage tolerance design	FY2006-2010	79,400
Tetsuya Yao	Osaka University/Graduate School of Engineering/Professor	Development of method for ultimate longitudinal strength assessment of ship hull girder under combined loading	FY2006-2009	87,800

Principal Investigator		Title	Term of project	Total (Thousand yen)
Hiroshi Azechi	Osaka University/Institute of Laser Engineering/Professor	Concept Exploration of Impact Fast Ignition	FY2006-2010	86,900
Hirofumi Yamada	Kyoto University/Graduate School of Engineering/Associate Professor	Proximal multi-probe measurement and control method for nanometer-scale structures based on frequency modulation AFM	FY2007-2011	76,100
Daisuke Shindo	Tohoku University/Institute of Multidisciplinary Research for Advanced Materials/Professor	Development of electron holography system for photoexcitation phenomena and its applications to materials science	FY2007-2011	90,400
Masayuki Nakao	The University of Tokyo/Graduate School of Engineering/Professor	Molding multi-layered precise structures widely and seamlessly	FY2007-2011	85,000
Yuji Nagasaka	Keio University/Faculty of Science and Technology/Professor	Development of Innovative Nano-Micro Level Thermophysical Properties Sensing Techniques and Their Applications	FY2007-2011	94,300
Akira Toriumi	The University of Tokyo/Graduate School of Engineering/Professor	Understanding and Control of Electronic Properties of Nanometer-thick Dielectric Films	FY2007-2011	79,100
Hiroshi Kawarada	Waseda University/Faculty of Science and Engineering/Professor	Development of High Power and Millimeter-long Wave Diamond Transistors Using Two Dimensional Hole Gas	FY2007-2011	84,700
Kazuhiro Hane	Tohoku University/Graduate School of Engineering/Professor	Study of optical micro systems by monolithic integration of silicon with nitride semiconductor	FY2007-2011	83,700
Taikan Oki	The University of Tokyo/Institute of Industrial Science/Professor	Developing an Integrated Water Cycle Model for Sustainability Assessment of World Water Resources	FY2007-2011	77,800
Tatsuo Omura	Tohoku University/Graduate School of Engineering/Professor	Development of virus-binding protein-based technologies for concentration, detection and identification of pathogenic viruses in water environment	FY2007-2011	85,600
Yoshiyuki Suzuki	Ritsumeikan University/Ritsumeikan Global Innovation Research Organization/Professor	Study on Development of Design Method for Traditional Wooden Buildings Based on Structural Details	FY2007-2011	75,000
Takeshi Nakagawa	Waseda University/Faculty of Science and Engineering/Professor	Reconstruction of the historical environment on Complex of Hue monuments -The reappearance made by CG technology and the establishment of GIS-	FY2007-2011	84,600
Kiyohito Ishida	Tohoku University/Graduate School of Engineering/Professor	New Functional Co-base Alloys - Phase Stability and Its Industrial Applications -	FY2007-2011	85,000
Sadahiro Tsurekawa	Kumamoto University/Faculty of Engineering/Guest Professor	Innovation in Electromagnetic Science of Materials and Its Application to Practical Materials Processing	FY2007-2011	81,200
Shinya Matsuo	Osaka University/Graduate School of Engineering/Professor	High Speed Reaction Field of Stable/Metastable Bulks Mixed in Nano-Scale and Its Applications	FY2007-2011	80,600
Takashi Tatsumi	Tokyo Institute of Technology/Chemical Resources Laboratory/Professor	Creation and diversification of novel porous materials with controllable nanospaces and sophisticated molecular recognition functions	FY2007-2011	86,000
Takeshi Kinoshita	The University of Tokyo/Institute of Industrial Science/Professor	Study on forecast and evading of Freak wave	FY2007-2011	74,600
Masayoshi Kawai	High Energy Accelerator Research Organization/Professors emeritus	Comprehensive study on material damage mechanism by experimental and theoretical methods and development of materials for high-energy quantum-beam fields	FY2007-2009	85,800

Biological Sciences （75 Projects）

○ Biology（20 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Naoyuki Takahata	The Graduate University for Advanced Studies/Hayama Center/Professor	Evolution by loss of genes that have become redundantin relation to changing environments	FY2004–2008	80,200
Yoshihiro Yoneda	Osaka University/Graduate School of Frontier Biosciences/Professor	Regulation of nucleocytoplasmic protein transport and nuclear stress response	FY2004–2008	80,400
Hiroki Nishida	Osaka University/Graduate School of Science/Professor	Control of embryogenesis of ascidians by localized mRNAs and embryonic induction	FY2004–2008	80,500
Yutaka Tochihara	Kyushu University/Faculty of Design/Professor	Environmental adaptability of Japanese to artificial environments	FY2004–2008	79,500
Yoshifumi Miyazaki	Chiba University/Center for Environment,Health and Field Sciences/Professor	Attempt to systematize physiological anthropology from viewpoints of "theoretical physiological anthropology" and "experimentalphysiological anthropology	FY2004–2008	78,900
Ikuko Nishimura	Kyoto University/Graduate School of Science/Professor	Vacuolar processing system responsible for programmed cell death in plants	FY2005–2009	87,100
Kazuo Sutoh	The University of Tokyo/Graduate School of Arts and Sciences/Professor	Molecular studies on force generation of recombinant dynein based on its structure and dynamics	FY2005–2009	82,500
Keiichi Nakayama	Kyushu University/Medical Institute of Bioregulation/Professor	Isolation and characterization of protrudin, a master regulator of neurite formation	FY2005–2009	85,900
Hisato Kondoh	Osaka University/Graduate School of Frontier Biosciences/Professor	Regulation and interaction of SOX family transcription factors as the basis of neural primordial development	FY2005–2009	86,700
Yuji Mizoguchi	National Science Museum/Department of Anthropology/Chief Curator	Synthetic research on the transition of the Japanese from the Pleistocene to the Jomon and Yayoi periods	FY2005–2009	76,900
Makoto Matsuoka	Nagoya University/Bioscience and Biotechnology Center/Professor	Study on gibberellin perception	FY2006–2010	86,000
Kazuyoshi Tsutsui	Waseda University/Faculty of Education and Integrated Arts and Sciences/Professor	Novel Mechanisms of the Regulation of Reproduction by Novel Brain Hormones	FY2006–2010	82,900
Toshiya Endo	Nagoya University/Graduate School of Science/Professor	Control and alteration of mitochondrial protein traffic	FY2006–2010	86,000
Masasuke Yoshida	Tokyo Institute of Technology/Natural Resources Laboratory/professor	Structure, rotation, and regulation of ATP synthase (FoF1)	FY2006–2010	85,600
Yoshikazu Nakamura	University of Tokyo/Institute of Medical Science/Professor	Sequence Complementarity–Independent Functional RNAs	FY2006–2010	87,000
Shinji Takada	National Institutes of Natural Sciences/Okazaki Institute for Integrative Biosciences/Professor	Molecular mechanism underlying metameric morphogenesis	FY2006–2010	85,400
Shintaroh Ueda	The University of Tokyo/Graduate School of Sciences/Professor	Ancient Chinese: their Genetic Diversity and Life History	FY2006–2010	81,300

Principal Investigator		Title	Term of project	Total (Thousand yen)
Yoshitaka Fukada	The University of Tokyo/Graduate School of Science/Professor	Molecular Analysis of Light-signaling and Circadian Rhythm in the Brain	FY2007-2011	81,600
Haruo Saito	The University of Tokyo/The Institute of Medical Science/Professor	Osmoregulatory MAP kinase signal transduction pathway	FY2007-2011	81,800
Juichi Yamagiwa	Kyoto University/Graduate School of Science/Professor	Evolutionary Anthropology of Conflicts and Resolution	FY2007-2011	74,000

○ Agricultural sciences（16 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Shigetou Namba	The University of Tokyo/Graduate School of Agricultural and Life Sciences/Professor	Postgenomics of plant pathogenic microorganisms that live intracellularly	FY2004-2008	81,800
Michio Kishi	Hokkaido University/Graduate School of Fisheries Sciences/Professor	Historical transition and prediction of Northern Pacific ecosystem associated with human impact and climate change	FY2004-2008	81,100
Eimei Sato	Tohoku University/Graduate School of Agricultural Science/Professor	Analysis of regulatory mechanisms of differentiation and apoptosis of mammalian oocytes for establishment of developmental biotechnology in next generation	FY2004-2008	80,400
Shinji Tsuyumu	Shizuoka University/Graduate School of Science and Technology/Professor	Elucidation of mechanism involved in suppressor activity of avirulent genes and its application for control of plant diseases	FY2005-2009	85,700
Yasuo Igarashi	The University of Tokyo/Graduate School of Agricultural and Life Sciences/Professor	The diversity of biological carbon dioxide pathways and biochemical understandings on their evolutional processes	FY2005-2009	79,200
Shizufumi Ebihara	Nagoya University/Graduate School of Bioagricultural Sciences/Professor	Molecular Mechanisms of Vertebrate Photoperiodism	FY2005-2009	86,000
Akiyoshi Fukamizu	University of Tsukuba/Graduate School of Environmental and Life Sciences/Professor	Molecular basis on the feto-maternal network in pregnancy-associated diseases	FY2005-2009	83,300
Ichiro Ueda	Hokkaido University/Graduate School of Agriculture/Professor	Modification of plant gene expression by viral gene silencing suppressors	FY2006-2010	74,800
Katsuhiko Kitamoto	The University of Tokyo/Graduate School of Agricultural and Life Sciences/Professor	Understanding of high protein secretion capability in koji mold by molecular and cellular biology techniques and its use as a cell factory	FY2006-2010	86,200
Tomoaki Niimi	Nagoya University/Graduate School of Bioagricultural Sciences/Assistant Professor	Development of novel therapy in regenerative medicine by application of human laminins produced in yeast	FY2006-2009	73,800
Kazuhiko Imakawa	The University of Tokyo/Graduate School of Agricultural and Life Sciences/Associate Professor	Remodeling on molecular mechanisms of pregnancy establishment and regulation	FY2006-2010	86,000
Takashi Tsuge	Nagoya University/Graduate School of Bioagricultural Sciences/Professor	Comparative genomics of the conditionally dispensable chromosomes controlling plant infection in Alternaria alternata pathogens	FY2007-2011	79,000
Ryuichiro Sato	The University of Tokyo/Graduate School of Agricultural and Life Sciences/Professor	Studies on molecular mechanisms of lipid accumulation in adipocytes for anti-metabolic syndrome	FY2007-2011	79,900

Principal Investigator		Title	Term of project	Total (Thousand yen)
Shugo Watabe	The University of Tokyo/Graduate School of Agricultural and Life Sciences/Professor	Genome-wide study on the regulation of fish muscle differentiation	FY2007-2011	79,500
Noboru Murakami	University of Miyazaki/Faculty of Agriculture/Professor	Translational research on novel peptides in veterinary and livestock science	FY2007-2011	79,000
Ko Shimamoto	Nara Institute of Science and Technology/Graduate School of Biological Science/Professor	Molecular basis of Rac GTPase in plant innate immunity	FY2007-2011	74,600

○ Medicine, dentistry, and pharmacy（39 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Masahiko Yamaguchi	Tohoku University/Graduate School of Pharmaceutical Sciences/Professor	Organoheteroatom Chemistry Based on Transition Metal Catalysis	FY2004-2008	90,100
Satoshi Inoue	The University of Tokyo/University Hospital/Assistant Professor	Molecular basis of nuclear receptors and their downstream targets in aging	FY2004-2008	88,600
Iekuni Ichikawa	Tokai University/School of Medicine/Professor	Recovery from Glomerular Sclerosis	FY2004-2008	82,600
Sunao Kaneko	Hirosaki University/Faculty of Medicine/Professor	Analysis of molecular biology of epilepsy:Development of personalized medicine for epilepsy based upon genetic polymorphisms	FY2004-2008	92,200
Kazuwa Nakao	Kyoto University/Graduate School of Medicine/Professor	Molecular basis and development of novel diagnostic/therapeutic modalities for the metabolic syndrome based on adipocyte endocrinology and adiposcience	FY2004-2008	88,000
Naoki Suzuki	The Jikei University/School of Medicine/Professor	Development of a New Endoscopic Surgical Robot System with Haptic Sensations and Navigational Function	FY2004-2008	75,700
Masato Hirata	Kyushu University/ Faculty of Dental Science/Professor	Studies on a novel signaling molecule, PRIP involved in GABAA receptor function	FY2004-2008	87,300
Fuyuhiko Inagaki	Hokkaido University/Graduate School of Pharmaceutical Sciences/Professor	Structural Biology of Innate Immunity	FY2005-2009	87,900
Masamitsu Iino	The University of Tokyo/Graduate School of Medicine/Professor	Imaging Study of Dynamic Cellular Signaling	FY2005-2009	90,500
Yoichi Nabeshima	Kyoto University/Graduate School of Medicine/Professor	Study of bioresponse system regulated by the Klotho/Na+,K+ATPase complex	FY2005-2009	87,200
Seiji Ito	Kansai Medical University/Department of Medical Chemistry/Professor	Systematic study on the mechanism of generation, maintenance and recognition of neuropathic pain, a model of neural plasticity	FY2005-2009	86,500
Kiyoji Tanaka	Osaka University/Graduate School of Frontier Biosciences/Professor	Molecular genetics on human disorders with a defect in cellular response to DNA damage which inhibits a transcription	FY2005-2009	87,300
Akio Koizumi	Kyoto University/Graduate School of Medicine/Professor	The genetic epidemiology of cerebrovascular diseases with high risk genetic factors to establish the secondary prevention program targeting high risk subjects	FY2005-2009	67,300

Principal Investigator		Title	Term of project	Total (Thousand yen)
Kohzoh Imai	Sapporo Medical University/President	Molecular pathogenesis of epigenetic alterations in gastrointestinal cancer and its application to diagnosis and treatment	FY2005-2009	85,200
Koichi Akashi	Kyushu University Hospital/University Hospital/Professor	Cancer stem cells and genes responsible for their development	FY2005-2009	92,300
Chikao Morimoto	The University of Tokyo/Institute of Medical Science/Professor	Basic study for determine the structure and function of CD26 for development of molecular target therapy for autoimmune disorders and immune deficiency syndrome	FY2005-2009	86,200
Masayuki Amagai	Keio University/School of Medicine/Professor	Elucidation of tolerance mechanism against peripheral target antigens in autoimmune diseases	FY2005-2009	85,500
Masaki Mori	Osaka University/Graduate School of Medicine/Professor	Analysis of esophageal cancer with molecular genetics and molecular epidemiology	FY2005-2009	86,200
Hiroshi Ueda	Nagasaki University/Graduate School of Biomedical Sciences/Professor	Identification of target molecules for cure of neuropathic pain accompanied with demyelination	FY2005-2009	83,300
Yoshio Hayashi	The University of Tokushima/Graduate School, Institute of Health Biosciences/Professor	Molecular analysis of pathogenesis on Sjogren's syndrome and its application of new diagnosis and therapy	FY2005-2009	86,100
Akira Matsuda	Hokkaido University/Faculty of Pharmaceutical Sciences/Professor	Development of new functional nucleic acids having nuclease-resistant properties being included in a multi-functional envelope type nano device	FY2006-2010	83,200
Tetsuya Terasaki	Tohoku University/Graduate School of Pharmaceutical Sciences/Professor	Proteomics-based Analysis of Blood-Brain Barrier Transport System	FY2006-2010	85,500
Hiroto Okayama	The University of Tokyo/Graduate School of Medicine/Professor	Molecular Mechanism of Anchorage-Dependent and -Independent S Phase Onset	FY2006-2010	86,700
Akio Nomoto	The University of Tokyo/Graduate School of Medicine/Professor	Poliovirus dissemination and host functions	FY2006-2010	87,200
Akihiko Yoshimura	Keio University/School of Medicine/Professor	Molecular mechanism of cytokine signal and immune regulation	FY2006-2010	86,800
Masaru Taniguchi	RIKEN/Lab of Immune Regulation/Group Director	The mechanisms of development and differentiation in Valpha14 NKT cells	FY2006-2010	86,600
Hiroshi Shimokata	National Center for Geriatrics and Gerontology/Department of Epidemiology/Director	A large-scale interdisciplinary longitudinal study on mental health in the middle-aged and elderly persons - development of strategy for prevention	FY2006-2010	79,100
Shuichi Kaneko	Kanazawa University/Graduate School of Medicine/Professor	Overfeeding breaks down liver function and results in life-style related disease	FY2006-2010	77,400
Takashi Yamamura	National Institute of Neuroscience/Department of Immunology/Director	Exploration and Identification of Biomarkers of Multiple Sclerosis Which is Relevant for Management and Research of MS	FY2006-2010	103,600
Masaki Noda	Tokyo Medical and Dental University/Medical Research Institute/Professor	Molecular Analyses of Osteoblastic Niche and its Application with the Development of Nano Science	FY2006-2010	84,200
Yuzo Ninomiya	Kyushu University/Graduate School of Dental Sciences/Professor	Taste Signaling Mechanisms for the Regulation of Food Intake: Approaches to Establishment for Taste Health Science	FY2006-2010	86,500

Principal Investigator		Title	Term of project	Total (Thousand yen)
Gozoh Tsujimoto	Kyoto University/Graduate School of Pharmaceutical Sciences/Professor	New genome medicine and drug discovery based on the comprehensive transcriptome analysis	FY2007–2011	85,200
Akihito Yamaguchi	Osaka University/The Institute of Scientific and Industrial Research/Professor	Structures, functions, regulations and physiological roles of xenobiotic exporters	FY2007–2011	84,400
Masayuki Miura	The University of Tokyo/Graduate School of Pharmaceutical Sciences/Professor	Visualization of oscillation for stress signal and molecular genetic study of establishment of cell community	FY2007–2011	84,400
Yasunori Okada	Keio University/School of Medicine/Professor	Functional analyses and regulation of the metabolism of tissue microenvironmental factors by metalloproteinases	FY2007–2011	89,700
Takashi Saito	RIKEN/Laboratory for Cell Signaling/Group Director	Spatiotemporal regulation of antigen recognition and activation of T cells	FY2007–2011	84,400
Tatsutoshi Nakahata	Kyoto University/Graduate School of Medicine/Professor	Analyses of proliferation and differentiation mechanisms of human embryonic stem cells and discovery of basic technology for clinical setting	FY2007–2009	84,000
Kozo Nakamura	The University of Tokyo/University Hospital/Professor	Comprehensive Study of Osteoarthritis for Elucidation of the Etiology and Identification of the Molecular Target of Treatment: The ROAD Study	FY2007–2011	85,300
Masaharu Takigawa	Okayama University/Graduate School of Medicine, Dentistry and Pharmaceutical Sciences/Professor	Comprehensive study on molecular basis of action of CCN family proteins as novel signal conductors and its translational application	FY2007–2011	85,000

Grant-in-Aid for Young Scientists (S)

☐ Distribution by Research Area of the Newly Adopted Projects

Purpose and Character of Grant-in-Aid for Young Scientists (S) (excerpt from the "Application Procedures for Grants-in-Aid for Scientific Research"):

1) **Intended for:**
A research project conducted by one researcher aged 42 or less as of April 1, 2008 (a person born on April 2, 1965, or thereafter) with an original idea that is expected to bring forth a major development in research, through his or her leadership of a team of research members*, based on past achievements
*A team involving Research Collaborators (young researchers, graduate students, overseas co-researchers, research assistants and others) that a Principal Investigator forms to implement a research project

2) **Total budget provided:** From 30 million yen to around 100 million yen (approx.)

3) **Research period:** Five years

4) **Number of research projects scheduled to be selected:** Around 30 (subject to strict selection)

【 New Projects】

	Number of Applications			Total Grant Disbursements (FY2008)	Per-project Grants (FY2008)	
	Received	Adopted	Ratio		Average	Largest
			(%)	(in thousands of yen)	(in thousands of yen)	(in thousands of yen)
Integrated Science and Innovative Science	197	10	5.1	196,900	19,690	55,800
Humanities and Social Sciences	22	1	4.5	16,600	16,600	16,600
Science and Engineering	316	17	5.4	329,000	19,353	29,300
Biological Sciences	270	11	4.1	269,600	24,509	35,800
Total	805	39	4.8	812,100	20,823	55,800

【 New and Ongoing Projects 】

	Number of Applications	Total Grant Disbursements (FY2008)	Per-project Grants (FY2008)	
			Average	Largest
		(in thousands of yen)	(in thousands of yen)	(in thousands of yen)
Integrated Science and Innovative Science	17	314,900	18,524	55,800
Humanities and Social Sciences	5	52,300	10,460	22,400
Science and Engineering	29	562,700	19,403	29,400
Biological Sciences	23	482,200	20,965	35,800
Total	74	1,412,100	19,082	55,800

※ Figure reflects only direct funding

List of the Newly Adopted Projects for Grant-in-Aid for Young Scientists (S) of KAKENHI、FY2008

(1)Integrated Science and Innovative Science (10 Projects)

○ Comprehensive fields (8 Projects)

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Gentaro Taga	The University of Tokyo/Graduate School of Education/Associate professor	Developmental brain sciences toward understanding of origin of intelligence	FY2008-2012	6,900 80,000
Haruhiko Bito	The University of Tokyo/Graduate School of Medicine/Associate Professor	Activity-dependent mechanisms regulating dendritic morphology and function	FY2008-2012	9,400 80,600
Michiko Shirane	Kyushu University/Medical institute of Bioregulation/Associate Professor	Molecular mechanisms for neuronal function via vesicular trafficking	FY2008-2012	16,200 77,000
Mitsutoshi Setou	Hamamatsu University School of Medicine/Molecular Imaging Frontier Research Center/Professor	Multi-dimensional Omics on Brain Anatomy	FY2008-2012	14,100 78,100
Masaki Fukata	National Institute for Physiological Sciences/Department of Cell Physiology/Professor	Synaptic regulatory mechanisms by novel AMPA receptor modulators	FY2008-2012	14,100 78,100
Masahito Ikawa	Osaka University/Research Institute for Microbial Diseases/Associate Professor	In vivo gene function analysis using lentiviral vector	FY2008-2012	10,500 74,500
Masaru Tanaka	Tohoku University/Institute of Multidisciplinary Research for Advanced Materials/Associate Professor	Inhibitory effects on the growth of cancer cells using surface topography	FY2008-2012	22,500 74,500
Daichi Nozaki	The University of Tokyo/Graduate School of Education/Associate Professor	Neural processes underlying motor control and learning of bimanual movement	FY2008-2012	24,000 66,900

○ New multidisciplinary fields (2 Projects)

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Michihiro Mochida	Nagoya University/Institute for Advanced Research/Associate Professor	Atmospheric aerosol properties inferred from their external mixing state	FY2008-2012	55,800 80,100
Tadaaki Nagao	National Institute for Materials Science/Materials Nanoarchitectonics/Independent Young Scientist	Architectonics of metallic nano-materials and infrared plasmons	FY2008-2012	23,400 88,900

(2)Humanities and Social Sciences (1 Projects)

○ Humanities (1 Projects)

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Naoya Katsumata	Kyoto University/Graduate School of Human and Environmental Studies/Associate Professor	Judaism's view of humankind: creation of a textual database on minorities and suggestions for modern society	FY2008-2012	16,600 81,400

(3)Science and Engineering （17 Projects）

○ Mathematical and physical sciences（5 Projects）

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Tetsushi Ito	Kyoto University/Graduate School of Science/Assistant Professor	Comprehensive studies on Shimura varieties, arithmetic geometry, Galois representations, and automorphic representations	FY2008-2012	6,200
				29,400
Daisuke Yonetoku	Kanazawa University/School of Mathematics and Physics/Assistant Professor	Polarization Measurement aboard the Satellite and Solution of the Emission Mechanism of the Gamma-Ray Bursts	FY2008-2012	29,100
				49,900
Naoki Yoshida	Nagoya University/Graduate School of Science/Assistant Professor	Simulations of the Formation, Evolution, and Clustering of Early Cosmic Structure	FY2008-2012	22,100
				49,300
Tsuyoshi Nakaya	Kyoto University/Graduate School of Science/Associate Professor	Study of Neutrino Mixing by using accelerator neutrino beams.	FY2008-2012	15,600
				64,100
Tsuyoshi Kimura	Osaka University/Graduate school of Engineering Science/Professor	Correlation between magnetic and dielectric properties	FY2008-2012	17,200
				57,200

○ Chemistry（4 Projects）

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Shinichi Ohkoshi	The University of Tokyo/Graduate School of Science/Professor	Study of photo-spin science on the next-generation with multiple phase transition materials	FY2008-2012	17,200
				81,200
Ken Tanaka	Tokyo University of Agriculture and Technology/Institute of Symbiotic Science and Technology/Associate Professor	Development of Innovative Molecular Transformations via Cationic Rhodacycles as Active Species	FY2008-2012	29,300
				65,400
Masaharu Nakamura	Kyoto University/Institute for Chemical Research/Professor	Development of New Synthetic Organic Reactions Based on the Universal Metals Catalysis	FY2008-2012	10,500
				80,500
Kazuya Kikuchi	Osaka University/Graduate School of Engineering/Professor	Design, Synthesis and Biological Application of Chemical Probes for in vivo Imaging	FY2008-2012	20,300
				81,500

○ Engineering Ⅰ（5 Projects）

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Takahito Ono	Tohoku University/Graduate School of Engineering/Associate Professor	Sensing Based on Nanomechanical systems coupled with stochastic resonance	FY2008-2012	16,800
				77,600
Seiichi Hata	Tokyo Institute of Technology/Precision and Intelligence Laboratory/Associate Professor	Combinatorial Search and Nanoprocessing of Pt-free Amorphous Alloys for Glass Molding Die	FY2008-2012	23,700
				82,100
Hiroaki Kakiuchi	Osaka University/Graduate School of Engineering/Associate Professor	Development of highly efficient fabrication process of thin film devices on plastic materials using atmospheric-pressure plasma	FY2008-2012	7,100
				61,500
Mamoru Tanahashi	Tokyo Institute of Technology/Graduate School of Science and Engineering/Associate Professor	A Study on Lean Turbulent Premixed Flame and Its Nonlinear Controls by Multi-Dimensional/Multi-Variable Laser Diagnostics and Large-Scale DNS	FY2008-2012	22,800
				75,800
Takao Someya	The University of Tokyo/Graduate School of Engineering/Associate Professor	Stretchable Large-Area Integrated Circuits by Nano-Printing Technology	FY2008-2012	27,500
				73,100

○ Engineering Ⅱ（3 Projects）

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Shuji Himeno	Nagaoka University of Technology/School of Engineering/Associate Professor	Development of CO2 Separation and Recovery Technology with High Performance CO2 Separation Membrane for Emission Limitation of Greenhouse Gases.	FY2008-2012	27,500
				77,900
Hiroyuki Fukuyama	Tohoku University/Institute of Multidisciplinary Research for Advanced Materials/Professor	Novel Processing of High Quality Aluminum Nitride Crystal using High Temperature Chemical Reaction Fields – Its Polarity and Growth Mechanism	FY2008-2012	24,500
				75,800
Takuji Waseda	The University of Tokyo/Graduate School of Frontier Sciences/Associate Professor	Observational study to determine the causes of the freak wave generation in the open ocean	FY2008-2012	11,600
				58,900

（4）Biological Sciences （11Projects）

○ Biology（3 Projects）

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Kouki Hikosaka	Tohoku University/Graduate School of Life Sciences/Associate Professor	A study of plant adaptation to elevated CO2 using CO2 springs as a future ecosystem	FY2008-2012	35,300
				80,100
Hiroaki Miki	Osaka University/Institute for Protein Research/Professor	Role of PIP3 Transport in Regulation of Cell Polarity	FY2008-2012	12,800
				70,200
Shosei Yoshida	Kyoto University/Graduate School of Medicine/Assistant Professor	Cell-biological investigation of the stem cell system that supports the mammalian spermatogenesis	FY2008-2012	17,200
				79,500

○ Agricultural sciences （2 Projects）

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Masao Watanabe	Tohoku University/Graduate School of Life Sciences/Professor	Molecular basis of self/non-self recognition in self-incompatibility on cruciferous plants	FY2008-2012	12,000
				80,000
Keiji Tanimoto	University of Tsukuba/Graduate School of Life and Environmental Sciences/Associate Professor	Mechanisms for methylation imprinting establishment after fertilization	FY2008-2012	26,600
				80,000

○ Medicine, dentistry, and pharmacy Ⅰ（3 Projects）

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Masayuki Inoue	The University of Tokyo/Graduate School of Pharmaceutical Sciences/Professor	Total Syntheses and New Biological Applications of Architecturally Complex Natural Products	FY2008-2012	29,200
				81,200
Hirofumi Shimizu	University of Fukui/Department of Medical Sciences/Assistant Professor	Simultaneous recording of conformational changes and ionic currents of single-molecular ion channels reveals the relationship between membrane potentials and motions of the channels	FY2008-2012	35,800
				70,600
Akinori Takaoka	Hokkaido University/Institute for Genetic Medicine/Professor	Molecular mechanisms for the detection of microbes and cancer cells in innate immunity	FY2008-2012	18,000
				77,200

○ Medicine, dentistry, and pharmacy Ⅱ (3 Projects)

Principal Investigator		Title	Term of project	Annual Budget (Thousand Yen)
Fumihiko Ishikawa	RIKEN/Research Center for Allergy and Immunology/Unit Leader	Mechanisms of chemotherapy resistance in human acute myelogenous leukemia (AML) stem cells	FY2008-2012	33,700
				65,700
Koji Yasutomo	The University of Tokushima/Graduate School Institute of Health Biosciences/Professor	Establishment of autoimmune disease therapies based on the elucidation of target genes	FY2008-2012	25,200
				81,200
Satoshi Fukumoto	Tohoku University/Graduate School of Dentistry/Professor	Analysis and regulation of tooth morphogenesis	FY2008-2012	23,800
				78,100

Developmental brain sciences toward understanding of origin of intelligence

Gentaro Taga
(The University of Tokyo, Graduate School of Education, Associate professor)

【Outline of survey】

The aim of our project is to understand the developmental origin of human intelligence. The intelligence involves generation of adaptive behaviors in the physical and social environment and acquisition of knowledge, which enriches one's mind and produces individual diversity. To detect emergence of and developmental changes in various types of intelligence, we conduct multidisciplinary studies involving brain imaging using near infrared optical topography, measurement of eye and body movements, psychological testing and dynamical systems modeling. We focus on the issues of domain specificity/generality of development, U-shaped development, sensitive periods and plasticity, interference of learning and development over different time scales, and the origin of rational thinking. We try to capture dynamic changes in behaviors and functional brain activations in early infancy and construct a new framework for system-level understanding of innateness and development of human intelligence.

【Expected results】

We expect to gain a deeper understanding of the relationship between the innate constraints and experience-dependent mechanisms for the acquisition of intelligence on behavioral and neural levels. This project will not only add new findings in special fields of cognitive science, behavioral science, neuroscience and developmental psychology, but also provide a new vision of development in pediatrics, childcare, education, engineering and philosophy, each of which pursues essential understanding of human being.

【References by the principal investigator】

・G. Taga, K. Asakawa, A. Maki, Y. Konishi, H. Koizumi: Brain imaging in awake infants by near infrared optical topography. PNAS, 100-19, 10722-10727, 2003
・H. Watanabe, G. Taga: General to specific development of movement patterns and memory for contingency between actions and events in young infants. Infant Behav.Dev. 29, 402-422, 2006
・F. Homae, H. Watanabe, T. Nakano, G. Taga: Speech perception in the developing brain. Neurosci. Res. 59, 29-39, 2007

【Term of project】 FY2008− 2012	【Budget allocation】 **80,000,000 yen** (direct cost)

【Homepage address】 http://www.p.u-tokyo.ac.jp/~taga/

Activity-dependent mechanisms regulating dendritic morphology and function

Haruhiko Bito

(The University of Tokyo, Graduate School of Medicine, Associate Professor)

【Outline of survey】

A fundamental question is how an ensemble behavior of 100 billion neurons can possibly give rise to a coherent and integrated “brain” that controls the whole human organism. Our central nervous system is physically wired and organized based on evolutionary and developmental principles that are primarily encoded into the genome and that are highly conserved in mammals from rodents to primates. This neural network, however, is also able to recognize and memorize external and internal events as they occur, and flexibly act based on memories of experienced events. We aim to address the basic signal transduction mechanisms which mediate the interaction between electrical and chemical signaling in the dendritic compartments and which allows information to be written and re-written into the neuronal circuits.

Specifically, we will examine: 1) the mechanisms underlying the formation and maturation of the dendritic morphology; and 2) the mechanisms by which local synaptic events can induce neuron-wide global changes via activation of transcriptional, translational and cytoskeletal processes; 3) the mechanisms that instruct individual synapses to alter or to maintain its responsiveness upon establishment of a global neuron-wide change in input-output function.

【Expected results】

Through this research project, we expect to better understand the precise nature and the whole spectrum of the molecular changes, both local and global, in the neurons undergoing profound modifications of the synaptic wiring, during development and in adult animals. Furthermore, we will identify key molecular and cellular mechanisms and principles that govern information processing and storage in active neuronal circuits.

【References by the principal investigator】

- Takemoto-Kimura S, Ageta-Ishihara N, Nonaka M, Adachi-Morishima A, Mano T, Okamura M, Fujii H, Fuse T, Hoshino M, Suzuki S, Kojima M, Mishina M, Okuno H, Bito H. Regulation of dendritogenesis via a lipid raft-associated Ca^{2+}/calmodulin-dependent protein kinase CLICK-III/CaMKI . *Neuron* 54: 755-770, 2007.
- Ohmae S, Takemoto-Kimura S, Okamura M, Adachi-Morishima A, Nonaka M, Fuse T, Kida S, Tanji M, Furuyashiki T, Arakawa Y, Narumiya S, Okuno H, Bito H. Molecular identification and characterization of a family of kinases with homology to Ca^{2+}/calmodulin-dependent protein kinases I/IV. *J. Biol. Chem.* 281: 20427-20439, 2006.

【Term of project】 FY2008－2012	【Budget allocation】 80,600,000 yen (direct cost)

【Homepage address】 http://www.neurochem.m.u-tokyo.ac.jp/Homepage.html

Molecular mechanisms for neuronal function via vesicular trafficking

Michiko Shirane
(Kyushu University, Medical institute of Bioregulation, Associate Professor)

【Outline of survey】

In cells, proteins, lipids, or several molecules can travel via membrane-enclosed compartments, which are referred to transport vesicles. This membrane traffic flows along highly organized, directional routes, which allow the cell to secrete, eat, and remodel its plasma membrane.

A neuron is extraordinary above all for its enormously extended shape, with a long axon and branching dendrites connecting it through synapses to other cells. The axon and dendrites, known as neurites, enable neuron to receive, conduct, and transmit signals. To perform the specific task, neuron seems to possess a special system for vesicular trafficking. However, little is known about the precise mechanism for the neuron-specific vesicular trafficking.

During the neurite formation, membrane components are transported in a directional manner within the cell by a membrane recycling system, resulting in expansion of the cell surface area in the region of neurite formation. We isolated a novel protein protrudin, which promotes neurite formation through regulation of the membrane recycling system. It was recently shown that protrudin is also related to neuronal function as it is mutated in a neurodegenerative disease.
In this research project, we aim to elucidate the mechanisms for the regulation of the neuron-specific vesicular trafficking and the related neurodegenerative disease.

【Expected results】

This project will contribute to understanding the biological relevance of neuron-specific vesicular trafficking in neuronal function. Through this project, it is also expected the practical use of the knowledge for the clinical application in neurodegenerative disease.

【References by the principal investigator】

- Shirane, M., Ogawa, M., Motoyama, J. & Nakayama, K.I. (2008) Regulation of apoptosis and neurite extension by FKBP38 is required for neural tube formation in the mouse. **Genes Cells,** in press.
- Shirane, M. and Nakayama, K. I. (2006) Protrudin induces neurite formation by directional membrane trafficking. **Science**, 314: 818-821.
- Shirane, M. and Nakayama, K. I. (2003) Immunophilin FKBP38, an inherent inhibitor of calcineurin, targets Bcl-2 to mitochondria and inhibits apoptosis. **Nature Cell Biol.**, 5: 28-37.

【Term of project】 FY2008− 2012	【Budget allocation】 **77,000,000 yen** (direct cost)

【Homepage address】 http://www.bioreg.kyushu-u.ac.jp/saibou.html

Multi-dimensional Omics on Brain Anatomy

Mitsutoshi Setou
(Hamamatsu University School of Medicine, Molecular Imaging Frontier Research Center, Professor)

【Outline of survey】

Immunohistochemistry for proteins and *in situ* hybridization for mRNA are used for the observation of biomolecules with a microscope. However, these techniques can only observe the already-identified biomolecules. We developed a new mass spectrometric microscopy which can observe various biomolecules at once with molecular weight. Our preliminary data showed dynamic distribution of the lipids, glycolipids, and proteins. In this study, we will make mouse brain mass imaging ATLAS. In addition, we will try to analyze mouse development, aging, sex, feeding, and the response for physiological stimulations. We use neurodegenerative disease model mice to establish our analytical system. Further, analysis of human postmortem brain will be in scope. Finally, we will try pathological analysis of postmoterm brains of human psychiatric diseases patients.

【Expected results】

The constituent elements of brain are water, lipids, proteins, glycolipids, nucleic acids, and others in the order of weight percentage. Because the techniques for observing the distribution of lipids and glycolipids had been limited, these distributions were hardly described. Our preliminary data with mass microscopy shows that lipids and glycolipids distributed dynamically. Thus, our survey will open a new field. Moreover, we can expect the discovery of new biomolecules by analyzing human neuronal diseases including schizophrenia.

【References by the principal researcher】

- Yao, I., Takagi, H., Ageta, H., Kahyo, T., Sato, S., Hatanaka, K., Fukuda, Y., Chiba, T., Morone, N., Yuasa, S., Inokuchi, K., Ohtsuka, T., MacGregor, G.R., Tanaka, K., and Setou, M. SCRAPPER-dependent ubiquitination of active zone protein RIM1 regulates synaptic vesicle release. ***Cell***, 130, 5, 943-957, (2007)
- Shimma, S., Sugiura, Y., Hayasaka, T., Zaima N., Matsumoto, M., and Setou, M. Mass imaging and identification of biomolecules with MALDI-QIT-TOF-based system. ***Anal. Chem.*** 80, 878-885, (2008)

【Term of project】 FY2008－2012	【Budget allocation】 78,100,000 yen (direct cost)

【Homepage address】

http://www2.hama-med.ac.jp/w3a/mifrc/mole-ana/setou/ja/index.html

Synaptic regulatory mechanisms by novel AMPA receptor modulators

Masaki Fukata

(National Institute for Physiological Sciences, Department of Cell Physiology, Professor)

【Outline of survey】

AMPA receptors (AMPARs) mediate most fast excitatory synaptic transmission in brain. The activity dependent changes of AMPAR-mediated synaptic transmission are thought to be critical for learning and memory. Therefore, the regulatory mechanisms of AMPAR functions are the foremost issue in modern neuroscience. In this project, we clarify the regulatory mechanisms of synaptic transmission by focusing on novel regulators of AMPARs: 1) the PSD-95 palmitoylating enzyme, which determines the synaptic position of PSD-95 scaffold, and 2) the epilepsy-related ligand/receptor, LGI1/ADAM22. We also elucidate the relationship between AMPARs and Alzheimer's disease-related proteins. Taken together, we clarify regulatory mechanisms for synaptic function and dysfunction.

【Expected results】

The misregulation of synaptic transmission causes various neurological disorders, including dementia and epilepsy. Because AMPARs mediate most excitatory synaptic transmission in brain, clarifying the regulatory mechanisms of AMPARs should contribute to understanding the pathogenesis of above neurological disorders. Because enzymes and ligands/receptors are targets for about two-third of all drugs in use today, our originally identified palmitoylating enzymes and epilepsy-related ligand/receptor could become therapeutic targets for synaptic disorders.

【References by the principal investigator】

1. Fukata Y., Adesnik H., Iwanaga T., Bredt D. S., Nicoll R. A., and Fukata M. Epilepsy-related ligand/receptor complex LGI1 and ADAM22 regulates synaptic transmission. ***Science*** 313, 1792-1795, 2006
2. Fukata, Y., Iwanaga, T., and Fukata, M. Systematic screening for palmitoyl transferase activity of the DHHC protein family in mammalian cells. ***Methods*** 40, 177-182, 2006
3. Fukata, M., Fukata, Y., Adesnik, H., Nicoll, R.A., and Bredt, D.S. Identification of PSD-95 palmitoylating enzymes. ***Neuron*** 44, 987-996, 2004

【Term of project】 FY2008− 2012	【Budget allocation】 **78,100,000 yen** (direct cost)

【Homepage address】 http://www.nips.ac.jp/fukata/

In vivo gene function analysis using lentiviral vector

Masahito Ikawa
(Osaka University, Research Institute for Microbial Diseases, Associate Professor)

【Outline of survey】

Lentiviral (LV) vectors are efficiently integrated into the host genome and stably express the transgene for life-time so that they have been successfully used in biological and biomedical studies. We have previously demonstrated that lentiviral vector transduction of fertilized eggs is a facile and efficient method to generated transgenic animals (LV-Tg method). In this project, we are going to develop an "*in vivo* gene function analysis system" using LV-Tg method. For this purpose, tissue specific gene modification with cre/loxP system, targeted gene knockdown with RNAi system, and inducible gene expression with tet on/off system will be examined in combination with lentiviral vector mediated gene trap mutagenesis. Throughout the project, we investigate the gene trapped mice and elucidate the mechanism of reproduction at molecular basis. All the mice obtained will be distributed through public bioresource center.

【Expected results】

Combination with LV-Tg method with other techniques will provide a novel gene function analysis system that promotes biological science in the post-genome project. Since the knockout mice will be distributed through bioresource center, the individual researcher need not to generate mutant mice by themselves. Elucidation of the mechanism of reproduction and its clinical applications might help the couples suffered from infertility.

【References by the principal investigator】

- Inoue N., Ikawa M., Isotani A., and Okabe M. "The immunoglobulin superfamily protein Izumo is required for sperm to fuse with eggs" Nature 434, 234-238 (2005)
- Okada Y., Ueshin Y., Isotani A., Saito-Fujita T., Nakashima H., Kimura K., Mizoguchi A., Oh-Hora M., Mori Y., Ogata M., Oshima R.G., Okabe M., and Ikawa M. "Complementation of placental defects and embryonic lethality by trophoblast-specific lentiviral gene transfer" Nature Biotechnology. 25, 233-237 (2007)

【Term of project】 FY2008－2012	【Budget allocation】 74,500,000 yen (direct cost)

【Homepage address】

http://kumikae01.gen-info.osaka-u.ac.jp/members/ikawa/index.htm

Inhibitory effects on the growth of cancer cells using surface topography

Masaru Tanaka

(Tohoku University, Institute of Multidisciplinary Research for Advanced Materials, Associate Professor)

【Outline of survey】

Three-dimensional (3D) porous scaffolds fabricated from biodegradable polymers have widely been used as temporary extracellular matrices, and play critical roles in tissue engineering. We have already known that nano-micro patterns on the surface of the scaffold have significant influences on the morphology, proliferation, differentiation and functions of various normal cells. However, effects of the scaffolds on cancer cells are not known yet. We have reported a honeycomb-patterned polymer film (honeycomb film) with highly regular pores that is formed by self-organization. The honeycomb films exerted a strong influence on cell morphology, proliferation, cytoskeleton, focal adhesion, and ECM production profiles. On the other hand, we have found the growth inhibition on the honeycomb film. In this study, we will examine the influence of the surface topography on the behavior of cancer cells, such as cell adhesion, detachment, cell-cycle, and motility on the honeycomb films as well as on a flat film in order to clarify the growth inhibition of cancer cells and how the cell recognize the surface topography.

【Expected results】

The design of nano- and microstructures based on self-organization would be a key area of research in the search for new materials, and it has a variety of potential applications in cancer and tissue engineering scaffolds. These results would have the potential benefit of honeycomb film in cancer research. This is the first study to propose novel concept of anti-cancer strategy using surface topography.

【References by the principal investigator】

・M. Tanaka, A. Takyama, E. Ito, H. Sunami, S. Yamamoto M. Shimomura, Effect of pore size of self-organized honeycomb-patterned polymer films on spreading, focal adhesion, proliferation, and function of endothelial cells, *J. Nanosci. Nanotech*, 7, 763-772, 2007.

【Term of project】 FY2008－2012	【Budget allocation】 74,500,000 yen (direct cost)

【Homepage address】 http://poly.tagen.tohoku.ac.jp/Site/Top.html

Neural processes underlying motor control and learning of bimanual movement

Daichi Nozaki
(The University of Tokyo, Graduate School of Education, Associate Professor)

【Outline of survey】

As symbolized by skillful movement during playing musical instruments and sports activity, human has an ability to perform a variety of movements by combining the movements of body parts such as arms and legs. A conventional research question is what neuronal mechanisms are involved in the spatial and/or temporal coordination of elemental movements. However, it seems necessary to reconsider the premise of the research question, because we have recently shown that compound movement is not constructed from the elemental movements. Specifically, distinct neuronal processes are likely to be involved in the control of the same left (right) arm movement across unimanual and bimanual movements. This new concept opens several novel research questions about the functional role, brain representation, process of selection, and acquisition of such multi-neuronal processes. This study aims to clarify the principle of how the CNS controls bimanual (or compound) movement by clarifying these questions using various methods such as motor learning experiment, brain functional imaging, and mathematical modeling.

【Expected results】

My hypothesis is that well-coordinated bimanual movement is achieved by mechanisms that flexibly switch neuronal processes for a limb control according to the kinematics of another limb. I believe that the exploration of the hypothesis will lead to a novel understanding for the bimanual movement control. Furthermore, the knowledge of the present research will provide a new rehabilitation technique for stroke patients and an efficient training program to develop bimanual motor skills.

【References by the principal investigator】

・Nozaki D, Kurtzer I, Scott SH. Limited transfer of learning between unimanual and bimanual skills within the same limb. Nature Neuroscience 9:1364-1366, 2006
・Yokoi A, Hirashima M, Nozaki D. Contralateral limb-dependent motor learning in bimanual movement. The 38th Annual Meeting of the Society for Neuroscience Abstract, 2008 (in press)

【Term of project】 FY2008− 2012	【Budget allocation】 66,900,000 yen (direct cost)

【Homepage address】 http://www.p.u-tokyo.ac.jp/~nozaki

Atmospheric aerosol properties inferred from their external mixing state

Michihiro Mochida

(Nagoya University, Institute for Advanced Research, Associate Professor)

【Outline of survey】

Global climate change is a serious environmental problem confronted by world societies. To date, some important factors regulating the Earth's climate remain unclear, which hinders prediction of future climate and determination of effective countermeasures. One factor is the relationship between airborne particles in the atmosphere (aerosol particles) and climate. Aerosol particles act as nuclei of cloud droplets and ice crystals; they are therefore closely related to cloud and precipitation processes. Moreover, aerosol particles and cloud droplets scatter and/or absorb solar radiation and influence the atmospheric energy balance. This study is designed to elucidate characteristics of aerosol particles according to differences in individual particles and the external mixing state. To achieve this, field observations are undertaken to segregate aerosol particles according to their size and hygroscopicity; then the physical and chemical properties are determined. The importance of the external mixing state of atmospheric aerosols and their relation to climate processes are discussed.

【Expected results】

This study will establish a method to determine both the external mixing state of atmospheric aerosols and the physical and chemical properties of the particles (composition, cloud condensation nuclei activity, and ice nucleation activity). This approach will reveal characteristics of atmospheric aerosol types (e.g., urban and marine) and their underlying aerosol processes. It is expected that the results of this project will contribute to future development of climate models.

【References by the principal investigator】

- Mochida M., M. Kuwata, T. Miyakawa, N. Takegawa, K. Kawamura, Y. Kondo: Relationship between hygroscopicity and cloud condensation nuclei activity for urban aerosols in Tokyo, *Journal of Geophysical Research*, 111, D23204, doi:10.1029/2005JD006980, 2006.
- Mochida M., T. Miyakawa, N. Takegawa, Y. Morino, K. Kawamura, Y. Kondo: Significant alteration in the hygroscopic properties of urban aerosol particles by the secondary formation of organics, *Geophysical Research Letters*, 35, L02804, doi:10.1029/2007GL031310, 2008.

【Term of project】 FY2008－2012	【Budget allocation】 80,100,000 yen (direct cost)

【Homepage address】 http://www.iar.nagoya-u.ac.jp/~mochida/

Architectonics of metallic nano-materials and infrared plasmons

Tadaaki Nagao

(National Institute for Materials Science, Materials Nanoarchitectonics,
Independent Young Scientist)

【Outline of survey】

In metallic material, electron system oscillates in a collective manner with ultrahigh frequencies. This oscillation is called plasmon and the world-wide active research field has emerged recently that aims at controlling the propagation, scattering, and the polarization of light in nanometer scale, by utilizing the coupling between the plasmon near the surface and external photon field. Normally, the plasmon frequency lies in visible to ultraviolet regime, but when the object shape becomes atomically thin, and the interaction between the objects becomes significant, the oscillation frequency shifts downwards to the infrared regime or lower with tiny nano-scale propagation wavelength.

In this project, we will establish the way for applying this novel knowledge for the realization of new classes of optical materials. We will explore various nano-metallic architecture, by adopting nanofabrication, colloidal process, as well as molecular atomic-layer epitaxy. In this way, we will establish a new methodology, which can be called as “nano-plasmotectonics”, for realizing innovative infrared optical materials.

【Expected results】

The optical functional properties explored here fits to the spectral region which is important in the field of environment, bio-sensing, and energy, and also matches to the requirement for the miniaturization of the future opto-electronic devices. Therefore, the outcomes from this project are highly expected to be applied in various fields as the evolution of nanotechnology proceeds. In the present project, along with the materials development, we will also develop new nano-measurement techniques and will feedback these results bidirectionally which should be highly effective in establishing the original methodology for developing innovative optical materials. In this way, we believe we can open the way for designing and realizing novel low-frequency plasmonic materials.

【References by the principal investigator】

・D. Enders, **T. Nagao**, and T. Nakayama, and M. Aono, “Precisely Controlled Fabrication of Highly Sensitive Au Sensor Film for Surface Enhanced Spectroscopy,” Japanese Journal of Applied Physics **49** (Express Letters), L1222-1224 (2007).

・**T. Nagao**, S. Yaginuma, T. Inaoka, and T. Sakurai, 'One-dimensional plasmon in atom wire array,' *Physical Review Letters*, 97, (2006) 116802.

・**T. Nagao**, 'Effects of the change in dimensionality on plasmons in metallic nanomaterials,' *OYO BUTURI*, 73, 1312-1318(2004) (front cover article).

【Term of project】 FY2008－2012	【Budget allocation】 **88,900,000 yen** (direct cost)

【Homepage address】

http://www.nims.go.jp/mana/members/young_scientist/t_nagao/index.html

Judaism's view of humankind: creation of a textual database on minorities and suggestions for modern society

Naoya KATSUMATA,

(Kyoto University, Graduate School of Human and Environmental Studies, Associate Professor)

【Outline of survey】

The purpose of this research is to gather primary texts (in Hebrew, Aramaic, Judeo-Arabic, Yiddish etc.) related to the problem of minorities in Judaism without regard to era, region or genre, read them carefully, analyze them, translate them into Japanese and English, register them in a database, and open them broadly to the general public. Specifically, this research shall create a comprehensive database of various types of text — searchable in the source language, Japanese and English — addressing the theme of how various types of minorities are created within the Jewish community by the Torah, which is founded on views on the pure/impure, the sacred/profane, and the noble/humble, and how these minorities were the object of differentiation/discrimination. Furthermore, the structure of this sort of differentiation/discrimination within Judaism shall be compared with the structure of differentiation/discrimination suffered by the Jewish minority at the hands of the majority during the Diaspora. The ultimate objective is to understand the nature of the Jewish view of humankind which lies at the root of its view of minorities.

【Expected results】

This research shall obtain a comprehensive understanding of the theme of minorities in Judaism, which has not been rigorously studied in Japan nor abroad. This research may also enable the establishment of a more universal model of the minority problem and the structure of discrimination by comparing the manifest Jewish view of minorities with those of other religions and cultures. It is expected that by examining this model, we will deepen our understanding of the minority problem in contemporary society, and obtain clues for solving it.

【References by the principal investigator】

・Naoya KATSUMATA, *The Liturgical Poetry of Nehemiah Ben Shelomoh Ben Heiman HaNasi: A Critical Edition*, Leiden, Boston and Köln: Brill Academic Publishers and Styx Publications, 2002

・Naoya KATSUMATA, *Hebrew Style in the Liturgical Poetry of Shmuel HaShlishi*, Leiden and Boston: Brill Academic Publishers and Styx Publications, 2003

【Term of project】 FY2008 － 2012	【Budget allocation】 **81,400,000 yen** (direct cost)

【Homepage address】 http://www.h.kyoto-u.ac.jp/staff/221_katsumata_n_0_j.html

Comprehensive studies on Shimura varieties, arithmetic geometry, Galois representations, and automorphic representations

Tetsushi Ito
(Kyoto University, Graduate School of Science, Assistant Professor)

【Outline of survey】

Shimura varieties are algebraic varieties (geometric objects defined by equations), which are generalizations of modular curves. Previously, several mathematical objects in arithmetic geometry, Galois representations, automorphic representations were studied from individual perspectives. However, these days, these are being studied from a unified viewpoint related to Shimura varieties, and many important applications are being obtained; examples are Fermat's last theorem proved by A. Wiles and the Sato-Tate conjecture proved in many cases by R. Taylor and his collaborators. In recent years, higher dimensional Shimura varieties are being studied extensively than before, and many essential applications of recently developed theories, such as rigid geometry, theory of p-adic uniformization, theory of (ϕ, Γ)-modules, are being obtained. In this project, we study Shimura varieties comprehensively with active young researchers including foreign ones, and we try to obtain new knowledge on arithmetic geometry, Galois representations, and automorphic representations.

【Expected results】

By studying integral models of Shimura varieties, we expect to understand the relation between p-adic uniformization of Shimura varieties and the etale cohomology of Rapoport-Zink spaces. We also expect to understand the geometric structures behind p-adic period maps, to understand the relation between the theory of (ϕ, Γ)-modules and the Langlands functoriality, to clarify the geometry behind the deformation theory of Galois representations, to obtain a new perspective on Shimura varieties, to obtain a new knowledge on the arithmetic geometry, Galois representations, and automorphic representations.

【References by the principal investigator】

・T. Ito, Weight-monodromy conjecture for p-adically uniformized varieties, Invent. Math. 159 (2005), no. 3, 607--656.
・T. Ito, Stringy Hodge numbers and p-adic Hodge theory, Compositio Math. 140 (2004), no. 6, 1499--1517.

【Term of project】 FY2008－2012	【Budget allocation】 29,400,000 yen (direct cost)

【Homepage address】 None

Polarization Measurement aboard the Satellite and Solution of the Emission Mechanism of the Gamma-Ray Bursts

Daisuke YONETOKU

(Kanazawa University, School of Mathematics and Physics, Assistant Professor)

【Outline of survey】

Gamma-Ray Bursts (GRBs) are well known as the biggest explosions in the universe which release a huge amount of energy, 10^{52} ergs, as the gamma-ray emission during the short time interval of several 10 seconds. GRBs are very bright, so we can use them to explore the early universe. However we have little knowledge about the emission mechanism of GRBs, and it is an important open question. Theoretically, it is thought to be a synchrotron radiation. If so, the radiations have strong polarization degree, and their detection is a key to solve the mechanism.

In this program, we develop a polarization detector and install it in the small solar-powered-sail satellite scheduled to launch in May, 2010. We realize the GRB polarization measurement for the first time. Our detector has a capability to measure the angular distribution of scattered gamma-ray photons via Compton effect.

During this program, we cover the detector development, the satellite launch, observations and publications of results. The gamma-ray polarization measurement is now noticed as the future observation technique, so we hope to establish the base of the gamma-ray polarization astronomy.

【Expected results】

The detector is small about 3 kg in weight, but we can realize the GRB polarization measurement overwhelmingly in short term schedule. We expect to detect the polarization signals from 2-4 GRBs and the Crab nebula during 1 year observations. Both GRB phenomena and the observation technique of the gamma-ray polarization are noticed in the astrophysical communities. Therefore we expect to obtain the observation results with the strong impact.

【References by the principal researcher】

- Gamma-Ray Burst Formation Rate Inferred from the Spectral Peak Energy-Peak Luminosity Relation: Yonetoku et al., The Astrophysical Journal, Volume 609, Issue 2, pp. 935-951. (2004)
- Possible observational evidence for the θ^{-2} angular distribution of the opening half-angle of GRB jet: Yonetoku et al., Monthly Notices of the Royal Astronomical Society, Vol.362, Issue.3, pp.1114 (2005)
- Spectral evolution of GRB 060904A observed with Swift and Suzaku: Yonetoku et al., Publications of the Astronomical Society of Japan, Vol.60, No.SP1, pp.S352 (2008)

【Term of project】 FY2008－2012	【Budget allocation】 49,900,000 yen (direct cost)

【Homepage address】 http://astro.s.kanazawa-u.ac.jp/~yonetoku/

Simulations of the Formation, Evolution, and Clustering of Early Cosmic Structure

Naoki Yoshida
(Nagoya University, Graduate School of Science , Assistant Professor)

【Outline of survey】

Large ground-based telescopes have discovered distant astronomical objects such as galaxies and quasars that were in place when the Universe was less than 1 billionyears old, corresponding to only about 5% of its current age. Moreover, these studies have shown that other luminous objects must have been present even earlier. Understanding how and when the first luminous objects were formed, and how they made the cosmic primordial gas to be in a plasma state is one of the major goals in modern cosmology and astronomy.

We study structure formation in the early universe using supercomputer simulations.

Our study will offer valuable inputs to future observations of the distant universe exploiting next-generation space-borne and ground-based telescopes.

【Expected results】

We use large three-dimensional cosmological simulations to reveal the following important properties of early cosmic structure.

1. The star-formation activities, gas metallicities of primeval galaxies
2. The evolution of chemical compositions in the inter-galactic medium
3. The effects of the nature of dark matter, dark energy, and models of inflaton field in the vry early universe on the above properties.

The results are extensively used to make proposals for surveys of the young Universe.

【References by the principal investigator】

- N. Yoshida, K. Omukai, L. Hernquist, “Protostar Formation in the Early Universe”, Science in press (2008)
- N. Yoshida, S. Oh, T. Kitayama, L. Hernquist, “Early Cosmological HII/HeIII Regions and Their Impact on Second-Generation Star Formation”, Astrophysical Journal, 663, 687 (2007)
- V. Springel, S. White, C. Frenk, A. Jenkins, N. Yoshida et al. “Simulations of the formation, evolution and clustering of galaxies and quasars”, Nature, 435, 629

【Term of project】 FY2008− 2012	【Budget allocation】 49,300,000 yen (direct cost)

【Homepage address】 http://www.a.phys.nagoya-u.ac.jp/~nyoshida/cosmo.html

Study of Neutrino Mixing by using accelerator neutrino beams.

NAKAYA Tsuyoshi
(Kyoto University, Graduate School of Science, Associate Professor)

【Outline of survey】

In order to reveal neutrino mixing phenomena and to measure the mass square difference of neutrinos, we conduct the accelerator neutrino beam experiments: SciBooNE and T2K.

In SciBooNE, the Fermilab neutrino beam is used to measure the neutrino interaction cross sections in low energy. In SciBooNE, we concentrate to understand the inelastic reactions which are serious backgrounds in the neutrino oscillation signals in T2K. We also measure the anti-neutrino cross section around 1GeV.

In T2K, we use the high power and high quality neutrino beam from J-PARC and the Super-Kamiokande neutrino detector to study neutrino mixing. In T2K, the near neutrino detector installed in J-PARC plays a crucial role to understand the property of the neutrino beam and neutrino interactions. In T2K, we conduct the precise measurements of neutrino oscillation parameters and the high-sensitive search for the rare process $\nu_\mu \rightarrow \nu_e$ to determine θ_{13}.

【Expected results】

1. World-best precision measurements of neutrino cross-sections around 1 GeV.
2. Precise measurements of neutrino oscillation parameters: θ_{23} and Δm_{23}^2
3. Most-sensitive search for the unknown neutrino oscillation channel $\nu_\mu \rightarrow \nu_e$ and the determination of θ_{13}.
4. For a future neutrino CP violation experiment, compile of necessary information of neutrino and anti-neutrino cross sections and the neutrino beam properties.

【References by the principal investigator】

- ”Measurement of neutrino oscillation by the K2K experiment”, M.H.Ahn, A.K.Ichikawa, T.Nakaya, M.Yokoyama et al., Phys. Rev. D74, 072003 (2006)
- ”Improved Search for $\nu_\mu \rightarrow \nu_e$ Oscillation in a Long-Baseline Accelerator Experiment”, S.Yamamoto, T.Nakaya et al., Phys. Rev. Lett 96, 181801 (2006)
- ”The JHF-Kamioka neutrino project”, Y.Itow, T.Nakaya et al., hep-ex/0106019

【Term of project】 FY2008－2012	【Budget allocation】 64,100,000 yen (direct cost)

【Homepage address】 http://www-he.scphys.kyoto-u.ac.jp/Neutrino/
http://www-he.scphys.kyoto-u.ac.jp/~nakaya

Correlation between magnetic and dielectric properties

Tsuyoshi Kimura
(Osaka University, Graduate school of Engineering Science, Professor)

【Outline of survey】

A magnetic field can be generated by the flow of an electrical current, which means intimate connection between an electric current and a magnetic field. In certain insulating materials, however, their magnetic properties can be changed by applying an electric field (not electric current). Such an unconventional coupling between magnetic and dielectric properties is termed *magnetoelectric* effect. The magnetoelectric effect defined as the generation of magnetization (electric polarization) by an electric (magnetic) field, has recently generated renewed attention since the effect can provide novel device design. In this research project, we investigate the following topics,

1. Development of materials with strong magnetoelectric coupling
2. Seeking novel magnetoelectric phenomena
3. Understanding of observed magnetoelectric phenomena
4. Proposal of novel measurements to study magnetism and/or dielectricity using magnetoelectric coupling.

Our goal is to construct a systematic research field concerning correlation between magnetism and dielectric property in solids.

【Expected results】

There have been no applications using magnetoelectric couplings developed to date, due mainly to materials limitations and the small magnitude of the effect. The success of the research project will be judged by the development of novel magnetoelectric materials and phenomena. The results will provide an important clue to device design for novel magnetoelectric memory elements or sensors.

【References by the principal investigator】

- "Cupric oxide as induced-multiferroic with high-T_C", T. Kimura, Y. Sekio, H. Nakamura, T. Siegrist, A. P. Ramirez, *Nature Mater.* **7**, 291-294 (2008).
- "Spiral magnets as magnetoelectrics", T. Kimura, *Annu. Rev. Mater. Res.* **37**, 387-413 (2007).

【Term of project】 FY2008－2012	【Budget allocation】 **57,200,000 yen** (direct cost)

【Homepage address】 http://www.crystal.mp.es.osaka-u.ac.jp/

Study of photo-spin science on the next-generation with multiple phase transition materials

Shin-ichi Ohkoshi

(The University of Tokyo, Graduate School of Science, Professor)

【Outline of survey】

A target of the research project is to create a novel phase transition in a chemically synthesized novel material which exhibits multiple phase transitions (ferromagnetism, ferroelectricity, spin transition, charge transfer transition, metal-insulator transition, spin reorientation, etc). Using these novel materials, we will also try to construct the next-generation photo-spin phenomena. In particular: (1) Development of novel multiple phase transition materials. (2) Creation of novel photo-spin phenomena such as photo-induced ferroelectric-ferromagnetism. (3) Establishment of "sub-terahertz magnetooptics" academic field by the first observation of the ferromagnetic resonance in 100-300 GHz range. (4) First observation of novel magnetization-induced nonlinear optical phenomena such as magnetization-induced nonlinear cascading process and magnetization-induced degenerated four-wave mixing.

【Expected results】

1. Development of novel multiple phase transition materials.
2. Creation of novel photo-spin phenomena such as photo-induced
3. ferroelectricity-ferromagnetism.
4. Establishment of the new magnetooptic field, sub-terahertz magnetooptics.
5. Proposal of new strategy for the next-generation opto-spinelectronic technology by first observation of the novel magnetization-induced nonlinear optic phenomena.

【References by the principal investigator】

- "Coexistence of Ferroelectricity and Ferromagnetism in a Rubidium Manganese Hexacyanoferrate", S. Ohkoshi, H. Tokoro, T. Matsuda, H. Takahashi, H. Irie, and K. Hashimoto, ***Angew. Chem. Int. Ed.***, 46, 3238 (2007).
- "Millimeter wave absorber based on gallium substituted ε-iron oxide nanomagnets", S. Ohkoshi, S. Kuroki, S. Sakurai, K. Matsumoto, K. Sato, and S. Sasaki, ***Angew. Chem. Int. Ed.***, 46, 8392 (2007).
- "Charge transfer-induced spin transition and photo-reversible magnetism in a cyano-bridged cobalt-tungstate bimetallic assembly", S. Ohkoshi, Y. Hamada, T. Matsuda, Y. Tsunobuchi, and H. Tokoro, ***Chem. Mater.***, 20, 3048 (2008).

【Term of project】 FY2008－2012	【Budget allocation】 81,200,000 yen (direct cost)

【ホームページアドレス】http://www.chem.s.u-tokyo.ac.jp/users/ssphys/index.html

Development of Innovative Molecular Transformations via Cationic Rhodacycles as Active Species

Ken Tanaka

(Tokyo University of Agriculture and Technology, Institute of Symbiotic Science and Technology, Associate Professor)

【Outline of survey】

It is well known that metallacycles are efficient intermediates of cycloadditions for the synthesis of various cyclic compounds. Recently, we first discovered that cationic rhodium(I) complexes bearing BINAP-type bisphosphine ligands are highly effective catalysts for [2 + 2 + 2] cycloadditions via metallacycles. In this research, we investigate a variety of methods for the generation of highly reactive cationic rhodacycles and their reactivity toward novel catalytic molecular transformations. We also examine the mechanism of these catalyses and develop asymmetric variants of these catalyses. Finally, we apply these catalyses to the synthesis of novel chiral ligands, extended π-conjugated compounds, functional polymers, and biologically active compounds.

【Expected results】

The catalyses developed by this research enable the catalytic asymmetric synthesis of chiral functionalized aromatic compounds with ease. The present catalyses serve as a powerful tool for the synthesis of novel chiral ligands and extended π-conjugated compounds, which may contribute to the growth of the Japanese chemical industry. Furthermore, elucidation of the reaction mechanism provides a new principle for the catalyst design.

【References by the principal investigator】

- Asymmetric Assembly of Aromatic Rings To Produce Tetra-*Ortho*-Substituted Axially Chiral Biaryl Phosphorus Compounds. Nishida, G.; Noguchi, K.; Hirano, M.; Tanaka, K.* *Angew. Chem. Int. Ed.* **2007**, *46*, 3951–3954.
- Rh-Catalyzed Synthesis of Helically Chiral and Ladder-Type Molecules via [2 + 2 + 2] and Formal [2 + 1 + 2 + 1] Cycloadditions Involving C–C Triple Bond Cleavage. Tanaka, K.*; Kamisawa, A.; Suda, T.; Noguchi, K.; Hirano, M. *J. Am. Chem. Soc.* **2007**, *129*, 12078–12079.

【Term of project】 FY2008– 2012	【Budget allocation】 **65,400,000 yen** (direct cost)

【Homepage address】 http://www.tuat.ac.jp/~tanaka-k/

Development of New Synthetic Organic Reactions Based on the Universal Metals Catalysis

Masaharu NAKAMURA

(Kyoto University, Institute for Chemical Research, Professor)

【Outline of survey】

A number of precisely controlled organic reactions have been developed with catalysts of the 4d and 5d late transition metals such as Ru, Rh, Pd, Ir, Pt, and Au. It has been difficult to apply the well-established ligand-control strategies to the tuning of the catalytic reactivities of the much more universally abundant 3d late transition metals, which we call the universal metals. This is mainly due to the capricious intrinsic properties associated with these 3d metal elements, namely oxidation states, coordination modes, and spin states. This Research program aims at the development of new catalysts based on the universal metals for selective organic synthesis and production of functional molecules. In order to establish a general concept for the modulation of the 3d late transition metal catalysts, our initial focus is on iron as a representative universal metal. We will develop new iron-catalyzed reactions and apply them to the creation and industrial production of functional organic molecules such as organic electronic devices, liquid crystals, and pharmaceuticals.

【Expected results】

We expect the following results: 1) development of iron-catalyzed cross-coupling reactions between halo-alkanes or arenes, and organo-magnesium, zinc, aluminum, and boron reagents; 2) development of iron-catalyzed carbon-nitrogen bond forming reactions; 3) development of iron-catalyzed catalytic enantioselective C–C bond forming reactions; and 4) their demonstrative application to the industrial production of functional molecules.

【References by the principal investigator】

"Iron-Catalyzed Selective Biaryl Coupling: Remarkable Suppression of Homocoupling by the Fluoride Anion" Hatakeyama, T.; Nakamura, M. *J. Am. Chem. Soc.* **2007**, *129*, 9844-9845.

"Iron-Catalyzed Cross-Coupling of Primary and Secondary Alkyl halide with Aryl Grignard Reagents" Nakamura, M.; Matsuo, K.; Ito, S.; Nakamura E *J. Am. Chem. Soc.* **2004**, *126*, 3686–3687.

【Term of project】 FY2008− 2012	【Budget allocation】 **80,500,000 yen** (direct cost)

【Homepage address】 http://es.kuicr.kyoto-u.ac.jp/

Design, Synthesis and Biological Application of Chemical Probes for *in vivo* Imaging

Kazuya Kikuchi

(Osaka University, Graduate School of Engineering, Professor)

【Outline of survey】

One of the great challenges in the post-genome era is to clarify the biological significance of intracellular molecules directly in living animals. If we can visualize a molecule in action, it is possible to acquire biological information, which is unavailable if we deal with cell homogenates. One possible approach is to design and synthesize chemical probes that can convert biological information to chemical output.

Real-time imaging of enzyme activities *in vivo* offers valuable information in understanding living systems and in the possibility to develop medicine to treat various forms of diseases. Magnetic resonance imaging (MRI) is an imaging modality adequate for *in vivo* studies. Therefore, many scientists are interested in the development of MRI probes capable of detecting enzyme activities *in vivo*. However, in the case of ^{1}H-MRI probes, interference from the background signals intrinsic to ^{1}H becomes problematic. Because such a background signal is hardly detectable, ^{19}F-MRI probes are promising for *in vivo* imaging. Despite this potential, few principles exist for designing ^{19}F-MRI probes to detect enzyme activities.

【Expected results】

A novel design strategy for ^{19}F-MRI probes to detect protease activities is proposed. The design principle is based on the paramagnetic relaxation effect from Gd^{3+} to ^{19}F. A peptide was synthesized, Gd-DOTA-DEVD-Tfb, attached to a Gd^{3+} complex at the N-terminus and a ^{19}F-containing group at the C-terminus. The ^{19}F-NMR transverse relaxation time (T_2) of the compound was largely shortened by the paramagnetic effect of intramolecular Gd^{3+}. The peptide was designed to have a sequence cleaved by an apoptotic protease, caspase-3. When the peptide was incubated with caspase-3, the peptide was cleaved and subsequently the Gd^{3+} complex and the ^{19}F-containing group were separated from each other. T_2, after cleavage, was extended to cancel the intramolecular paramagnetic interaction. T_2 is a parameter that can be used to generate contrasts in MR images. Using this probe as a positive contrast agent, the probe could detect enzyme activity spatially from a phantom image using ^{19}F MRI.

【Reference by the principal investigator】

S. Mizukami, R. Takikawa, F. Sugihara, Y. Hori, H. Tochio, M. Wälchli, M. Shirakawa & K. Kikuchi: “Paramagnetic Relaxation-based ^{19}F MRI Probe to Detect Protease Activity”, *J. Am. Chem. Soc.*, **130,** 794-795 (2008).

【Term of project】 FY2008－2012	【Budget allocation】 **81,500,000 yen** (direct cost)

【Homepage address】

http://www-molpro.mls.eng.osaka-u.ac.jp/mlsmpwww/toppageenglish.html

Sensing Based on Nanomechanical systems coupled with stochastic resonance

Takahito Ono
(Tohoku University, Graduate School of Engineering, Associate Professor)

【Outline of survey】

This research aims at developing nonlinear mechanical micro/nano-sensors with an ability of signal processing on the basis of stochastic resonance under applying external noise. For this purpose, nonlinear mechanical silicon resonators will be developed, and its binary state with large or small vibration amplitude is used as digital signal for processing. External stimulus to the sensors causes the transition between the binary states, which can be applied to applications for sensing. The transition probability is also influenced by the external stimulus. Mechanical signal processing using the large array of mechanically- or electrically-coupled resonators will be studied. This mechanical circuit can perform logical operation at the sensor level, which reduces the excess load to LSI and realizes smart systems. Signal amplification can be performed by adding noise to the binary state. Developing devices consisted of coupled resonators with ability of advanced signal processing is our objective.

【Expected results】

A kind of sensory organs of creatures is known to use stochastic resonance for signal amplification. In this research, we propose micro-nanomechanical solid state sensors mimic to biological sensory systems. In addition, signal processing ability at the sensor can make the system smart, which reduces the load to LSI and may realize more complex signal processing. A highly-developed sensor system with advanced functions mimic to biological sensory systems is expected to open novel approach to realize sensory systems for robotics and artificial sensory organ.

【References by the principal researcher】

- Takahito Ono, Shinya Yoshida, Yusuke Kawai, and Masayoshi Esashi
  Optical Amplification of the Resonance of a Bimetal Silicon Cantilever
  Applied Physics Letters, **90**, (2007), 243112-1~3.
- Takahito Ono, and Masayoshi Esashi
  Effect of ion attachment on mechanical dissipation of a resonator
  Applied Physics Letters **87**, 4 (2005), 044105-1~044105-3.

【Term of project】 FY2008－2012	【Budget allocation】 **77,600,000 yen** (direct cost)

【Homepage address】 http://www.mems.mech.tohoku.ac.jp/index.html

Combinatorial Search and Nanoprocessing of Pt-free Amorphous Alloys for Glass Molding Die

Seiichi Hata

(Tokyo Institute of Technology, Precision and Intelligence Laboratory, Associate Professor)

【Outline of survey】

In the production of micro and high-performance glass aspheric lenses with diffraction gratings, the process of molding the glass is critical. However, conventional molding die materials for glass lenses (WC or SiC) are sintered materials. It it difficult to produce diffraction gratings on them. In addition, a protective film of noble metal such as Pt alloy must be deposited on the die surface in order to prevent oxidation and fusion with the molten glass. This film blurs the edges of the gratings. The blurred edges degrade the optical performance of the molded lens. Industry has long desired a molding die material that is robust and that has a heat resistance comparable to those of conventional materials, that allows high-precision processing, and that requires no protective film.

The object of this project is to find a novel Pt-free amorphous alloy for the molding die and to perform high-precision fine processing (nanoprocessing) on the alloy. For creation and systematic search for a large number of alloy samples, combinatorial search is employed. Efficient search for the alloy and its nanoprocessing are realized by new combinatorial measurement method for the crystallization temperature of the amorphous alloys and new nanoprocessing that is not only diamond turning but also forming.

【Expected results】

This project will lead into miniaturizing and improving the performance of almost any optical glass component including lenses by realization of glass molding die with microstructures such as diffraction gratings made of the novel Pt-free amorphous alloy. The new combinatorial measurement methods and nanoprocessing methods are promising for a wide variety of technology field

【References by the principal investigator】

・Seiichi HATA, Junpei SAKURAI and Akira SHIMOKOHBE, Experimental fabrication of glass lens molding die made of novel Pt based amorphous alloy, Trans. Jpn. Soc. Mech. Eng C, 74, [740] 1020-1025 (2008)

・Seiichi HATA, Ryusuke YAMAUCHI, Junpei SAKURAI and Akira SHIMOKOHBE, Combinatorial Arc Plasma Deposition of Thin Films, Jpn. J. Appl. Phys., 45, [4A] 2708-2713 (2006)

【Term of project】 FY2008－2012	【Budget allocation】 82,100,000 yen (direct cost)

【Homepage address】 http://www.nano.pi.titech.ac.jp/hata-index.htm

Development of highly efficient fabrication process of thin film devices on plastic materials using atmospheric-pressure plasma

Hiroaki Kakiuchi

(Osaka University, Graduate School of Engineering, Associate Professor)

【Outline of survey】

During the last decades, there has been a steady increase in the utilization of plasma generated at atmospheric pressure. However, the application of atmospheric-pressure plasma seems to be limited to such fields as surface processing and material treatment. Our present study deals with the development of high-rate and low-temperature film growth processes using atmospheric-pressure very high-frequency (VHF) plasma, which is considered to be more appropriate than conventional low-pressure plasma processes for the fabrication of next-generation low-cost and high-performance thin film devices.

The aims of this survey are (1) to develop an electrode system for plasma excitation that can completely remove particulate contamination of the growing films, (2) to achieve high-rate and low-temperature (≤100 °C) depositions of good-quality functional thin films, such as microcrystalline silicon (μc-Si), silicon dioxide (SiO_2) and silicon nitride (SiN_x), and (3) to fabricate high-performance thin film transistors (TFTs) on plastic materials.

【Expected results】

On the basis of the atmospheric-pressure VHF plasma technology we have already developed for the high-rate deposition of functional thin films at low temperatures, we will realize a dust-free atmospheric-pressure plasma CVD system. Simultaneously, we will study critical deposition parameters to achieve highly efficient deposition processes of μc-Si, SiO_2 and SiN_x films having suitable structural and electrical properties for the fabrication of high-performance TFTs, which is very difficult only by improving the conventional low-pressure plasma processes. Consequently, the high potentials of our atmospheric-pressure VHF plasma technology will be demonstrated. The main positive contribution of this survey should be to give a motive force to accelerate practical applications of atmospheric-pressure plasma not only to surface processing but also to thin film fabrication processes.

【References by the principal investigator】

- H. Kakiuchi, H. Ohmi, M. Harada, H. Watanabe, and K. Yasutake, “Low-temperature formation of SiO_2 layers using a two-step atmospheric pressure plasma-enhanced deposition-oxidation process”, Appl. Phys. Lett. **91**, 161908 (2007).
- H. Kakiuchi, H. Ohmi, and K. Yasutake, “High-Rate and Low-Temperature Film Growth Technology Using Stable Glow Plasma at Atmospheric Pressure”, in *Trends in Thin Solid Films Research*, ed. Alyssa R. Jost (Nova Science, New York, 2007), pp. 1–50 (Chapter 1).

【Term of project】 FY2008－2012	【Budget allocation】 61,500,000 yen (direct cost)

【Homepage address】 http://www-ms.prec.eng.osaka-u.ac.jp/toptop.html

A Study on Lean Turbulent Premixed Flame and Its Nonlinear Controls by Multi-Dimensional/Multi-Variable Laser Diagnostics and Large-Scale DNS

Mamoru Tanahashi
(Tokyo Institute of Technology, Graduate School of Science and Engineering, Associate Professor)

【Outline of survey】

To overcome the recent environmental problems, development of high efficiency and low emission combustors is required. Flow fields of various combustors are in turbulent state, whereas details of the turbulent combustion have not yet been clarified. Therefore, the combustors in many applications have been developed through a trial and error process. In this study, lean turbulent premixed flame, which is a promising combustion technology for high efficiency and low emission combustors, is investigated by multi-dimensional/multi-variable laser diagnostics and large-scale direct numerical simulation (DNS) to develop a nonlinear active control scheme based on a nonlinear relation between turbulent flame structure and pressure fluctuation in the combustor. Furthermore, a sensor for monitoring combustion state, a control device and an active control algorithm are comprehensively developed to realize high efficiency and low emission combustors based on the nonlinear active control scheme, and a simulator for turbulent combustion controls based on large eddy simulation with high accuracy turbulent combustion model is constructed for estimation of control efficiency and low cost design of the combustors in many engineering applications.

【Expected results】

In this study, a sensor, a control device and an active control algorithm, which are important for the nonlinear active control of the combustor, will be comprehensively developed. Nonlinear relations between local flame structure in turbulence and combustion oscillation (or combustion noise) will be clarified by large-scale DNS and multi-dimensional/multi-variable laser diagnostics, and an active combustion control scheme based on the nonlinear relations will be established. The results of this study will realize high efficiency and low emission combustors such as gas turbine, and will contribute to conquest of the environmental problems.

【References by the principal investigator】

・M. Tanahashi T. Hirayama and T. Miyauchi, Measurement of Fine Scale Structure in Turbulence by Time-Resolved Dual-Plane Stereoscopic PIV, International Journal of Heat and Fluid Flow, Vol. 29, pp.792-802, 2008.
・M. Tanahashi, S. Taka, M. Shimura and T. Miyauchi, CH Double-pulsed PLIF Measurement in Turbulent Premixed Flame, Experiments in Fluids, in press.
・M. Tanahashi, Numerical Simulation of Combustion, Maruzen (2001).

【Term of project】 FY2008－2012	【Budget allocation】 75,800,000 yen (direct cost)

【Homepage address】 http://www.navier.mes.titech.ac.jp/

Stretchable Large-Area Integrated Circuits by Nano-Printing Technology

Takao Someya

(The University of Tokyo, Graduate School of Engineering, Associate Professor)

【Outline of survey】

There has been growing interest in organic transistors, because these emerging devices have several advantages over existing devices based on roll-to-roll and/or printing processes.

In this project, we will exploit the nano-printing technology to realize stretchable large-area integrated circuits.

First, we will establish a novel nano-printing technology with combining atto-liter inkjet and self-assembled monolayer. We will realize interconnections for organic transistors by stretchable conductors using carbon nanotube. In these approaches, we will realize stretchable large-area integrated circuits that can be applied on the curved surface like rubbery.

Second, we will apply conductive rubbers or conductive gels to stretchable integrated circuits. We will study fundamental physics and interfacial physics of these stretchable electric materials and devices, and build up the basic of new field as stretchable electronics.

【Expected results】

In the forthcoming ubiquitous electronics in the next generations, large-area sheet-type devices will play an important role. In this project, we will miniaturize organic transistors in the real nanometer regime by using printing process, and we realize high-performance, large-area organic transistor. We will also reveal the fundamental physics and interfacial physics of the stretchable electric materials and devices to build up the new field as stretchable electronics.

【References by the principal investigator】

Tsuyoshi Sekitani, Yoshiaki Noguchi, Ute Zschieschang, Hagen Klauk, and Takao Someya, "Organic transistors manufactured using inkjet technology with subfemtoliter accuracy", Proceedings of the National Academy of Sciences of the United States of America, Vol. 105, Issue 13, pp. 4976–4980 (Online March 24, 2008; April 1, 2008).

Takao Someya, Yusaku Kato, Tsuyoshi Sekitani, Shingo Iba, Yoshiaki Noguchi, Yousuke Murase, Hiroshi Kawaguchi, and Takayasu Sakurai, "Conformable, flexible, large-area networks of pressure and thermal sensors with organic transistor active matrixes", Proceedings of the National Academy of Sciences of the United States of America, Vol. 102, Issue 35, pp.12321-12325 (2005).

Takao Someya, Tsuyoshi Sekitani, Shingo Iba, Yusaku Kato, Hiroshi Kawaguchi, and Takayasu Sakurai, "A large-area, flexible pressure sensor matrix with organic field-effect transistors for artificial skin applications", Proceedings of the National Academy of Sciences of the United States of America, Vol. 101, Issue 27, pp. 9966-9970 (July 6, 2004).

【Term of project】 FY2008－2012	【Budget allocation】 73,100,000 yen (direct cost)

【Homepage address】 http://www.ntech.t.u-tokyo.ac.jp/

Development of CO_2 Separation and Recovery Technology with High Performance CO_2 Separation Membrane for Emission Limitation of Greenhouse Gases.

Shuji Himeno

(Nagaoka University of Technology, School of Engineering, Associate Professor)

【Outline of survey】

For suppression of global warming world-wide, reduction of CO_2 emissions and development of new energy resources should be accelerated around the world. Particularly, CO_2 recovery from thermal power stations and during drilling of petroleum and natural gas, which are potential sources of CO_2 emission, and using innovative energy-saving technologies are urgent issues. Furthermore, as new energy conversion technologies, utilization of energy from sewage sludge or food residues is sought. The objective of this study is application of a DDR-type zeolite membrane to recovery of CO_2 from natural gas and biogas. We have been developing the membrane, which has high CO_2 separation performance from methane which the primary constituent of natural gas and biogas. And this membrane has high performance especially at high pressures region. Further improvement of the membrane for possible application to CO_2 recovery technology from natural gases will be attempted. Moreover, elucidation of CO_2 separation mechanisms and construction of separation processes for practical applications will be promoted.

【Expected results】

We expect our results will broaden the application area of small molecule separation and collection such as CO_2 and hydrocarbons. Outcomes of this study of the membrane using molecular sieving of oxygen-containing eight-membered rings that DDR type zeolite possesses are expected to be applicable to new abundantly available membrane materials with other zeolite membrane having oxygen-containing eight-membered rings.

【References by the principal investigator】

・S. Himeno, T. Tomita, K.Suzuki, S. Yoshida, K. Nakayama, Synthesis and Permeation Properties of DD3R Zeolite Membrane for separation of CO_2/CH_4 Gaseous Mixtures. Ind. Eng. Chem. Res. 46:6989-6997 (2007)

・S. Himeno, T. Tomita, K. Suzuki, S. Yoshida, Characterization and Selectivity for Methane and Carbon Dioxide Adsorption on the All-Silica DD3R Zeolite, Microporous and Mesoporous Materials, 98, 62-69 (2007)

【Term of project】 FY2008－2012	【Budget allocation】 77,900,000 yen (direct cost)

【Homepage address】 http://shwmlab.nagaokaut.ac.jp/

Novel Processing of High Quality Aluminum Nitride Crystal using High Temperature Chemical Reaction Fields - Its Polarity and Growth Mechanism

Hiroyuki FUKUYAMA
(Tohoku University, Institute of Multidisciplinary Research for Advanced Materials, Professor)

【Outline of survey】

Recent trend for semiconductor light emitting devices is headed for shorter wavelength and higher energy. Ultraviolet (UV) light emitting devices are expected for a variety of application: next generation light source, information technology, medical and biotechnology, excitation light source for photocatalysis and nanotechnology. Single crystalline AlN is an ideal material as a substrate for the UV LED from the viewpoints of lattice match and UV transmittance. There is strong competition among Japan, United States and EU to develop AlN crystal. It is extremely difficult to grow a bulk AlN crystal from its melt because of its high melting point and high sublimation pressure. Therefore, the HVPE, flux and sublimation-recondensation methods are currently employed for producing a bulk AlN crystal. However, the crystalline quality and size are far from satisfaction. The present study is positioned as the breakthrough for the limits of the current crystal growth technology. I developed a unique method forming AlN thin films by nitriding sapphire based on thermodynamic consideration. The purpose of this study is developing a new process of high quality AlN crystal with the help of the AlN film using high temperature chemical reaction fields. The crystal growth mechanism of AlN is also studied taking into account the polarity.

【Expected results】

High quality AlN crystal obtained by the present study will significantly contribute to make high luminous efficiency UV LED. Technical expertise on polarity and surface morphology control will be obtained through development of the process using high temperature chemical reaction fields. In addition, scientific contribution to the nitride crystal growth will be greatly expected.

【References by the principal investigator】

・H. Fukuyama, S. Kusunoki, A. Hakomori and K. Hiraga: Single Crystalline Aluminum Nitride Films Fabricated by Nitriding α-Al_2O_3, J. Appl. Phys., Vol. 100 (2006), p.024905-1-7.
・T. Nagashima, M. Harada, H. Yanagi, H. Fukuyama, Y. Kumagai, A. Koukitu and K. Takada: Improvement of AlN Crystalline Quality with High Epitaxial Growth Rates by Hydride Vapor Phase Epitaxy, J. Crystal Growth, Vol. 305 (2007), p.355-359
・W. Nakao and H. Fukuyama: Single Crystalline AlN Film Formed by Direct Nitridation of Sapphire using Aluminum Oxynitride Buffer, J. Crystal Growth, Vol. 259 (2003), p.302-308

【Term of project】 FY2008－2012	【Budget allocation】 75,800,000 yen (direct cost)

【Homepage address】 http://www.tagen.tohoku.ac.jp/labo/fukuyama/index-j.html

Observational study to determine the causes of the freak wave generation in the open ocean

Takuji Waseda
(The University of Tokyo,Graduate School of Frontier Sciences,Associate Professor)

【Outline of survey】

Theoretical and experimental works suggest that the generation of freak wave is closely related to the instability of random water waves, but this has not been verified from field observation. Wave spectra in the ocean vary due to changes in the wind field and ocean current. In this study, we simultaneously measure the wind, current and wave to identify the environmental conditions that lead to the generation of the freak wave. Following hypotheses will be tested: i) dispersive energy focusing due to meteorological conditions; ii) geometrical energy focusing due to wave-current interaction; iii) generation of freak wave due to an instability of an abnormal wave spectra formed as a result of i) and ii).

We conduct the following: 1) establish a new buoy system to monitor freak waves in the deep ocean (near the Kuroshio extension); 2) analyses of the obtained time series from the moored buoy station containing freak wave; 3) comparison of the numerical simulation results and the satellite images with wave records and other measurements around the moored station from the intensive observational period.

【Expected results】

Simultaneous observation of wave, current and wind by moored and drifting buoys near a strong ocean current is rare. If a long-term monitoring is realized, the database of the wave-wind-current will be quite unique and we will likely be able to identify causes of the freak wave generation in the open ocean. We also expect to contribute to the study of the air-sea interaction (e.g. gas exchange) which is the original purpose of the moored buoy station in the Kuroshio extension.

【References by the principal investigator】

- Waseda, T., T. Kinoshita and H. Tamura, 2008: Evolution of random directional wave and extreme wave occurrence, ***J. Phys. Oceanogr.*** under review
- Tamura, Waseda, Miyazawa & Komatsu, 2008, Current-induced modulation of the ocean wave spectrum and the role of nonlinear energy transfer, ***J. Phys. Ocenogr.***, to be published

【Term of project】 FY2008－2012	【Budget allocation】 58,900,000 yen (direct cost)

【Homepage address】 http://waseda2.t.u-tokyo.ac.jp/~waseda

A study of plant adaptation to elevated CO_2 using CO_2 springs as a future ecosystem

HIKOSAKA, Kouki
(Tohoku University, Graduate School of Life Sciences, Associate Professor)

【Outline of survey】

Atmospheric CO_2 concentration is increasing and expected to double at the end of this century. Many studies have been conduted to understand plant responses to elevated CO_2. However, most of previous studies have used current plants that may adapt to current CO_2 concentration. We can expect that elevated CO_2 acts as a selective agent and plants that adapt to elevated CO_2 may evolve in future environments. The aim of the present study is to predict evolution of plants under future high-CO_2 world. We conduct ecophysiological and population-genetic studies for plants growing around CO_2 springs, where high CO_2 concentration has been maintained for long term. Furthermore, we conduct selection experiment to reproduce evolution under high CO_2 conditions.

【Expected results】

We will find advantageous and disadvantageous traits of plants under high CO_2 conditions and predict evolution of plants under future environment. This will contribute to prediction of future vegetation change and future ecosystem responses to global environmental change. Furthermore, our study will contribute to modelling of environmental response of plant growth. This model will be useful for understanding of evolutionary significance of plant traits and for improvement of agricultural yield.

【References by the principal investigator】

・Onoda Y, Hirose T, Hikosaka K (2007) Effect of elevated CO_2 on leaf starch, nitrogen and photosynthesis of plants growing at three natural CO_2 springs in Japan. *Ecological Research*, 22: 475-484.
・Miyagi KM, Kinugasa T, Hikosaka K, Hirose T (2007) Elevated CO_2 concentration, nitrogen use, and seed production in annual plants. *Global Change Biology*, 13: 2161-2170.

【Term of project】 FY2008− 2012	【Budget allocation】 80,100,000 yen (direct cost)

【Homepage address】 http://hostgk3.biology.tohoku.ac.jp/hikosaka/index.html

Role of PIP3 Transport in Regulation of Cell Polarity

Hiroaki Miki
(Osaka University, Institute for Protein Research, Professor)

【Outline of survey】

PIP3 is involved in diverse cell biological phenomena such as proliferation and differentiation. Recent studies have revealed that PIP3 accumulates at the leading edges of migrating cells and at the growth cones of axons, where it plays crucial roles in the regulation of cell polarity. However, the molecular mechanism of how PIP3, which constitutes the membrane, accumulates at such specialized areas remains largely unknown. I identified a microtubule-based motor protein as a novel substrate for a polarity-regulating kinase. It was found that this motor protein accumulates at the growth cones as does PIP3. A foreign research group has suggested that a motor protein associates with and transports PIP3-containing lipid vesicles.
These new findings raise the possibility that the PIP3 accumulation occurs via the transport on the cytoskeleton. In this project, I am going to investigate the regulatory and functional mechanisms of motor proteins and clarify the importance of the PIP3 transport in cell polarity.

【Expected results】

Since the discovery of PIP3, most researchers have focused on the enzymes that generate or degrade PIP3. In this point, the idea that PIP3 is recruited by the transport on the cytoskeleton is a very interesting one and this study will certainly produce valuable results with a strong impact on cell biology. Malfunction of PIP3 regulation is known to be responsible for several human diseases such as cancers and diabetes, and thus this study may clarify the link of the cytoskeleton and the motor protein with human diseases.

【References by the principal investigator】

- Miki et al. (1998) Induction of filopodium formation by a WASP-related actin-depolymerizing protein N-WASP. ***Nature*** 391, 93-96.
- Miki et al. (2000) IRSp53 is an essential intermediate between Rac and WAVE in the regulation of membrane ruffling. ***Nature*** 408, 732-735.
- Yamazaki et al. (2003) WAVE2 is required for directed cell migration and cardiovascular development. ***Nature*** 424, 452-456.
- Funato et al. (2006) The thioredoxin-related redox-regulating protein nucleoredoxin inhibits Wnt-β-catenin signaling through Dishevelled. ***Nat. Cell Biol.*** 8, 501-508.

【Term of project】 FY2008-2012	【Budget allocation】 70,200,000 yen (direct cost)

【Homepage address】 http://www.protein.osaka-u.ac.jp/intra_signal/index.html

Cell-biological investigation of the stem cell system that supports the mammalian spermatogenesis

Shosei Yoshida

(Kyoto University, Graduate School of Medicine, Assistant Professor)
（National Institutes of Natural Sciences ,National Institute for Basic Biology, Professor）

【Outline of survey】

Mammalians including humans exhibit a numerous daily sperm production for long reproduction period. This is supported by “stem cells” that supply differentiating progeny, while maintaining their own population. However, it is still largely a puzzle which cells the “stem cells” are among a numerous spermatogenic cells found in the testis, or, where and how the “stem cells” behave to ensure the continuous spermatogenesis.

Previous studies of our own have suggested that a particular subpopulation of transit amplifying cells retain the self-renewing potential, while do not self-renew in the normal spermatogenesis. This population may play an important backup role in replenishment of the occasional homeostatic stem cell loss, and thus ensure the spermatogenesis continuity. This research project will “look the shapes”, “clarify the locations”, “watch the movements” and “chase the fates” of these populations, taking advantages of a variety of experimental strategies. Subsequently, this study aims to reveal the entire composition and function of the “stem cell system” for the mammalian spermatogenesis.

【Expected results】

Results of this study would contribute toward a general understanding and control of the stem cell system, not only in spermatogenesis but also other system such as skin or blood stem cells. Revealing the mammalian spermatogenic stem cell system would contribute, on one hand, to the investigation and care of the male infertility in human. On the other hand, this would also lead to development of a novel contraceptive strategy against the global population problem.

【References by the principal investigator】

- T. Nakagawa, Y-i. Nabeshima and ***S. Yoshida**: Functional identification of the actual and potential stem cell compartments in mouse spermatogenesis
  Developmental Cell 12, 195-206 **(2007)**
- ***S. Yoshida**, M. Sukeno and Y-i. Nabeshima: A vasculature-associated niche for undifferentiated spermatogonia in the mouse testis
  Science 317, 1772-1776 **(2007)**

【Term of project】 FY2008−2012	【Budget allocation】 **79,500,000 yen** (direct cost)

【Homepage address】 http://lmls.med.kyoto-u.ac.jp

Molecular basis of self/non-self recognition in self-incompatibility on cruciferous plants

Masao Watanabe
(Tohoku University, Graduate School of Life Sciences, Professor)

【Outline of survey】

In higher plants, the genetic diversity is maintained by outcrossing. Self-incompatibility (SI) is one of outcrossing systems, which was written in C. Darwin's books. From my recent research, it has been revealed that *Brassica* SI, which is controlled by a single locus with multiple alleles, is regulated by allele-specific direct interaction between SP11 (male *S* determinant) and SRK (female *S* determinant). However, there is little information of the downstream signaling factor of SRK, at a moment. In this study, I aim to understand the intracellular signaling network of *Brassica* SI using two types of plant materials, self-compatible *B. rapa* and self-incompatible *Arabidopsis thaliana*, with multidisciplinary approach.

【Expected results】

SI is one of a model system of cell-cell communication in higher plants, and has been used in the production of F_1 hybrid variety in *Brassica* crops. Furthermore, a variety of genes encoding receptor kinase are contained in the genome of higher plants, although most of their functions were still unknown. This study will contribute to discover the downstream molecules of SI, and their intracellular signaling network and other orphan receptor kinase.

【References by the principal investigator】

- Takasaki, T., Hatakeyama, K., Suzuki, G., Watanabe, M., Isogai, A., and Hinata, K. (2000) SRK determines the *S* specificity of stigma in self-incompatible *Brassica*. Nature 403: 913-916.
- Murase, K., Shiba, H., Iwano, M., Che, F.-S., Watanabe, M., Isogai, A., and Takayama, S. (2004) A membrane-anchored protein kinase involved in *Brassica* self-incompatibility signaling. Science 303: 1516-1519.

【Term of project】 FY2008－2012	【Budget allocation】 80,000,000 yen (direct cost)

【Homepage address】 http://www.ige.tohoku.ac.jp/prg/watanabe/

Mechanisms for methylation imprinting establishment after fertilization

Keiji Tanimoto
(University of Tsukuba, Graduate School of Life and Environmental Sciences, Associate Professor)

【Outline of survey】

Mammals inherit one genome from each parent and most genes are expressed from both alleles. Normal embryonic development requires both a male and female genome, because some genes remember their parental origin and are transcribed quite specifically from only one of the two parental alleles (genomic imprinting). In the Igf2/H19 locus, the Igf2 gene is transcribed when paternally inherited, while the H19 gene is maternally transcribed. Imprinted genes are often associated with differentially methylated regions (DMRs) that control monoallelic gene expression. It is generally accepted that DMRs establish their allelic methylation during gametogenesis. Since some DMRs are methylated during oogenesis and others during spermatogenesis, it is suggested that DMRs contain genetic “marks” that allow (or prevent) methylation acquisition at nearby CpG dinucleotides in only one of the gametes. In this study, I propose to search for the DNA sequence that is required and sufficient for establishment of methylation imprinting, through which further understanding of the molecular mechanism of genomic imprinting is anticipated.

【Expected results】

By examining YAC (yeast artificial chromosome) transgenic mice, I have shown that genomic imprinting could be recapitulated at a heterologous genomic locus by simply grafting the H19 DMR into an irrelevant (human beta-globin) genetic locus. Surprisingly, methylation imprinting was established after fertilization in these transgenic mice, which was different from what is observed at the endogenous Igf2/H19 locus. By determining the minimal cis DNA sequences within the H19 DMR that establish the parent of origin-dependent methylation pattern during the post-fertilization period in this experimental system, we expect to define the molecular entity that must be inherited.

【References by the principal investigator】

・Tanimoto, K., Sugiura, A., Omori, A., Felsenfeld, G., Engel, JD., and Fukamizu, A. "Human beta-globin locus control region HS5 contains CTCF- and developmental stage-dependent enhancer-blocking activity in erythroid cells" *Mol. Cell. Biol.* **23**, 8946-8952 (2003)

・Tanimoto, K., Shimotsuma, M., Matsuzaki, H., Omori, A., Bungert, J., Engel, JD., and Fukamizu, A. "Genomic imprinting recapitulated in the human beta-globin locus" *Proc. Natl. Acad. Sci. USA* **102**, 10250-10255 (2005)

【Term of project】 FY2008− 2012

【Budget allocation】 80,000,000 yen (direct cost)

【Homepage address】 http://akif2.tara.tsukuba.ac.jp/

Total Syntheses and New Biological Applications of Architecturally Complex Natural Products

Masayuki Inoue
(The University of Tokyo, Graduate School of Pharmaceutical Sciences, Professor)

【Outline of survey】

Natural products have been tremendously important in biology and human medicine because of their power to modulate signal transductions of biological system. Three-dimensional structures of natural products are highly optimized for function through evolutionary processes; functional information is manifested by sophisticated assemblages of various ring systems and functional groups. Since the removal of sub-structures of the natural products often leads to significant losses of their activity, total syntheses of their entire structures with a precision at an atomic level are necessary to provide sufficient amounts of material required for biological and medical applications. Architecturally complex natural products with molecular weight over 1000 are capable of highly specific interactions with their target proteins. Therefore, they are powerful agents for selectively controlling intricate biological systems. In this research, we will develop new and efficient synthetic methodologies and strategies for the synthesis of highly complex compounds. We will then apply the synthetic natural products and designed artificial analogs for studying new functions and network of biological systems.

【Expected results】

The goal of our research program is efficient, practical and flexible syntheses of biologically important natural molecules. At the core of this research program is the development of new strategies for assembling architecturally complex natural products in a concise fashion. These synthetic developments would enable unified synthesis of new artificial analogs by modification of natural products templates. The new synthetic methods for the natural products and the synthetic analogs will allow us to tailor and enhance their druglike properties, to gain control over diverse signal transductions thereby offering new research methods for the study of life science.

【References by the principal researcher】

- M. Inoue, M. Hirama, et al. “Total Synthesis of Ciguatoxin and 51-HydroxyCTX3C,” *J. Am. Chem. Soc.* **2006**, *128*, 9352-9354.
- M. Inoue et al. “Total Synthesis and Bioactivity of an Unnatural Enantiomer of Merrilactone A: Development of an Enantioselective Desymmetrization Strategy,” *J. Org. Chem.* **2007**, *72*, 3065-3075.

【Term of project】 FY2008－2012	【Budget allocation】 **81,200,000 yen** (direct cost)

【Homepage address】 http://www.f.u-tokyo.ac.jp/~inoue/e_index.html

Simultaneous recording of conformational changes and ionic currents of single-molecular ion channels reveals the relationship between membrane potentials and motions of the channels

Hirofumi Shimizu
(University of Fukui, Faculty of Medical Sciences, Assistant Professor)

【Outline of survey】

In cell membranes or microorganisms, membrane proteins are always affected by membrane potentials and its oscillations in their activities. How do they move and function in these physiological conditions? To answer this fundamental question I plan to develop a new measurement system using ion channels as a testing molecule. Ion channels are signal transduction molecules which transduce various stimuli, such as chemical substances in the body and membrane potentials, to electrical signals or ionic stream that runs across the membrane. In this transduction process, it had been predicted there were conformational changes for the openings and closings of their ion permeation pathway (gating). Our research group recently succeeded in recording these conformational changes in a single molecule as movies, which revealed that an ion channel twisted around the axis of the pathway upon gating. In this study, I will develop new measuring devices which enable simultaneous recording of the conformational changes and ionic currents through the channels by integrating the existing method for recording currents and our method for detecting motions.

【Expected results】

The results of this research will elucidate the mechanism of signal transduction in cells by revealing the relationship between the “function” and “motion” of channels. The simultaneous measurement of a single molecule, not averaged image of many molecules, will allow a detailed analysis of the transduction mechanism that is an essential part of biological processes. Furthermore, the developed measuring devices can be adapted to all the other membrane proteins including important targets of drugs. Thus, the results would contribute to the understanding of the mechanism of drug action and designing of a new drug by examining not only the “functions” and “structures” but “motions” of their target.

【References by the principal investigator】

・Shimizu, H., *et.al.* (2008) Global twisting motion of KcsA potassium channel upon gating. Cell 132, 67-78.

【Term of project】 FY2008－2012	【Budget allocation】 **70,600,000 yen** (direct cost)

【Homepage address】 None

Molecular mechanisms for the detection of microbes and cancer cells in innate immunity

Akinori Takaoka
(Hokkaido University, Institute for Genetic Medicine, Professor)

【Outline of survey】

Infctious disease is still a formidable issue, to which it could provide a key to find how we control microbial infection. We will address this issue by focusing particularly on "microbial sensing", the first line of host defense in triggering innate immune responses. Recent rapid progress in studies on innate immunity has facilitated the identification of various sensors, such as TLRs (Toll-like receptors), that detect microbe-specific components, and has elucidated their critical roles in the activation of dendritic cells. Recently, we have identified a candidate cytosolic DNA sensor called DAI (DNA-dependent activator of IRFs, previously known as DLM-1 or ZBP1). In addition, evidence has been provided regarding the existence of additional DNA sensor(s). In this study, our aim is to find a novel DNA sensing molecule(s), to determine which microbes can be recognized by them, and to elucidate a mechanism for the activation of these sensors and the related signaling pathways, leading to the induction of cytokine/chemokine genes in innate immune responses. In addition, we try to investigate the mechanism for the activation of innate immunity in the eradication of cancer cells, particularly in terms of a possible involvement of "DNA sensing" in this process.

【Expected results】

This study will contribute to further understanding of the microbial sensing mechanism for the activation of innate immune responses. In addition, it will be expected that this project may also provide a new insight into the mechanism for the pathogenesis of DNA-related diseases including autoimmune diseases and inflammatory diseases, and offer some therapeutic basis to those intractable diseases. Our research will further clarify a mechanism underlying the activity of DNA as a potent immunostimulant particularly for vaccination. The analyses for the recognition of cancer cells could provide a novel concept to the activation process of innate immunity against cancer.

【References by the principal investigator】

- Takaoka, A., Wang, Z., Choi, M.K., Yanai, H., Negishi, H., Ban, T., Lu, Y., Miyagishi, M., Kodama, T., Honda, K., Ohba, Y., and Taniguchi, T. DAI (DLM-1/ZBP1) is a cytosolic DNA sensor and an activator of innate immune response. *Nature*, **448**, 501-505, 2007.
- Takaoka, A., and Taniguchi, T. Cytosolic DNA recognition for triggering innate immune responses. *Adv. Drug Deliv. Rev.*, **60**, 847-857, 2008.

【Term of project】 FY2008− 2012	【Budget allocation】 77,200,000 yen (direct cost)

【Homepage address】 http://www.igm.hokudai.ac.jp/sci/

Mechanisms of chemotherapy resistance in human acute myelogenous leukemia (AML) stem cells

Fumihiko Ishikawa, MD/PhD
(RIKEN, Research Center for Allergy and Immunology, Unit Leader)

【Outline of survey】

Acute myelogenous leukemia (AML) is one of the most common and intractable adult hematological malignancies that exhibits high relapse rate even following successful remission induction and hematopoietic stem cell transplantation. We have recently identified leukemic stem cells in AML that can self-renew, generate non-stem leukemic cells, and possess exclusive capacity to initiate leukemia in vivo. Transplantation of AML stem cells into NOD/SCID/IL2rgKO newborns successfully recapitulates human AML, which enables us to identify the role of leukemic stem cells in leukemogenesis and relapse. We aim to clarify the mechanisms of drug resistance underlying leukemia relapse by cell biological and global transcriptome analyses, with the ultimate goal of translating thus obtained research findings to the creation of novel therapeutic strategies for leukemia.

【Expected results】

The direct in vivo examination of stem cell properties such as stem-niche interaction, cell cycle quiescence, and drug efflux capacity as well as global gene expression profiling of leukemic stem cells enable us to identify the stem cell specific molecules and to develop therapeutic strategies to overcome AML relapse.

【References by the principal investigator】

- Ishikawa F, et al. Chemotherapy-resistant human AML stem cells home to and engraft within the bone marrow endosteal region. ***Nature Biotechnology*** 25:1315-21, 2007.
- Shultz LD, Ishikawa F, Greiner DL. Humanized mice in translational biomedical research. ***Nature Reviews Immunol*** , 7:118-130, 2007.
- Ishikawa F, et al. Development of functional human blood and immune systems in NOD/SCID/IL2rg chain null mice. ***Blood*** 106:1565-1573, 2005.

【Term of project】 FY2008－2012	【Budget allocation】 **65,700,000 yen** (direct cost)

【Homepage address】 http://web.rcai.riken.jp/en/labo/human/index.html

Establishment of autoimmune disease therapies based on the elucidation of target genes

Koji Yasutomo
(The University of Tokushima, Graduate School Institute of Health Biosciences, Professor)

【Outline of survey】

Most of the genes involved in autoimmune diseases remain unclear despite a variety of basic immunological and genetic studies. It is crucial to clarify the complex regulatory mechanisms that maintain the homeostasis of the immune system as well as acquire immune tolerance in order to establish therapeutic systems to treat autoimmune diseases. We plan to identify crucial genes that cause autoimmune diseases by genome wide screens in this study. In addition, we plan to clarify the roles of Notch signaling that is associated with T cell-mediated autoimmunity.

【Expected results】

The discovery of target genes that play key role in the etiology of autoimmune diseases would help establish targeted therapies to treat autoimmune diseases. Furthermore, such studies might help identify a novel regulatory mechanism to control immune homeostasis. Dissecting the specific roles of Notch in the immune system or elucidating the relationship between Notch and other regulatory systems would contribute not only to a better understanding of complex immune networks but also provide a new approach to modulate the immune systems.

【References by the principal investigator】

(1) Kijima M, et al. Dendritic cell-mediated NK cell activation is controlled by Jagged2-Notch interaction. Proc Natl Acad Sci USA 105: 7010-7015 (2008)
(2) Maekawa Y, et al. Delta1-Notch3 interactions bias the functional differentiation of activated CD4+ T-cells. Immunity 19:549-59 (2003).
(3) Yasutomo K, et al. Mutation of DNASE1 in people with systemic lupus erythematosus. Nat Genet. 28:313-4 (2001)
(4) Yasutomo K, et al. The duration of antigen receptor signalling determines CD4+ versus CD8+ T-cell lineage fate. Nature.404:506-10 (2000)

【Term of project】 FY2008 － 2012	【Budget allocation】 81,200,000 yen (direct cost)

【Homepage address】

http://immunology.hosp.med.tokushima-u.ac.jp/immunology/system/top/index.php

Analysis and regulation of tooth morphogenesis

Satoshi Fukumoto
(Tohoku University, Graduate School of Dentistry, Professor)

【Outline of survey】

In tooth morphogenesis, the dental epithelium and mesenchyme interact reciprocally for growth and differentiation to form the proper number and shapes of teeth. Previously, about twenty genes expressed in tooth specifically were identified by microarray and computer based differential display methods. Among of these genes, gap junctional molecule Gja1 is expressed in tooth germ. Gja1 null-mouse showed disorganization of ameloblasts. Epiprofin (Epfn) is tooth specific transcription factor. Epfn mutant showed increase number of tooth. Mutant mouse of down-stream signal molecules for ectodysplatin A showed decrease tooth width. These results indicated that these tooth specific molecules regulate tooth number and shape. We will analyze their gene function and molecular mechanism of abnormal tooth formation in their mutant mice.

【Expected results】

By this project, we will gain several novel molecular mechanisms for the determination of tooth size and shape. These discovered mechanisms will help to understand the morphogenesis of not only tooth, but also the organs formed by epithelial-mesenchymal interaction. It is possible to organize the artificial tooth, which has proper size and shape, using their information about tooth morphogenesis.

【References by the principal investigator】

・Yoshizaki K, Yamamoto S, Yamada A, Yuasa K, Iwamoto T, Fukumoto E, Harada H, Saito M, Nakasima A, Nonaka K, Yamada Y & Fukumoto S. Neurotrophic factor NT-4 regulates ameloblastin expression via full-length TrkB. **J Biol Chem** 283, 3385-3391, (2008).
・Fukumoto S, Miner JH, Ida H, Fukumoto E, Yuasa K, Miyazaki H, Hoffman MP & Yamada Y. Laminin alpha5 is required for dental epithelium growth and polarity and the development of tooth bud and shape. **J Biol Chem** 281, 5008-5016, (2006).
・Fukumoto S, KIba T, Hall B, Iehara N, Nakamura T, Longenecker G, Krebsbach PH, Nanci A, Kulkarni AB & Yamada Y. Ameloblastin is a cell adhesion molecule required for maintaining the differentiation state of ameloblast. **J Cell Biol** 167, 973-983, (2004).

【Term of project】 FY2008－2012	【Budget allocation】 **78,100,000 yen** (direct cost)
【Homepage address】	None

List of the Continuing Projects for Grant-in-Aid for Young Scientists (S) of KAKENHI

Integrated Science and Innovative Science (7 Projects)

○ Comprehensive fields(4 Projects)

Principal Investigator		Title	Term of project	Total (Thousand yen)
Katsuyuki Sakai	The University of Tokyo/Graduate School of Medicine /Associate Professor	Neural Mechanisms of Higher Thought Processes in Human	FY2007-2011	75,200
Mikio Hoshino	National Institute of Neuroscience/NCNP/Director	Strategy for producing a variety types of neurons by regulating spatial and temporal identities of neural stem cells	FY2007-2011	88,600
Hirokazu Hirai	Gunma University/Graduate School of Medicine/Professor	Establishment and application of lentivector-based production of gene-rescue mouse for exploring gene functions	FY2007-2011	79,600
Eiji Hoshi	Tamagawa University/Brain Science Institute/Associate Professor	Involvement of the frontal cortex, basal ganglia,and cerebellum in voluntary movement	FY2007-2011	88,500

○ New multidisciplinary fields(3 Projects)

Principal Investigator		Title	Term of project	Total (Thousand yen)
Mayumi Ishizuka	Hokkaido University/Graduate School of Veterinary Medicine/Associate Professor	Environmental impact of toxic substances on wildlife and species differences	FY2007-2011	86,600
Teruo Ono	Kyoto University/Institute for Chemical Research/Professor	Current-induced spin dynamics and its application to spintronic devices	FY2007-2011	87,000
Asako Sugimoto	RIKEN/Laboratory for Developmental Genomics/Team Leader	Gene networks that regulate dynamics of cytoskeletons in animal development	FY2007-2011	88,300

Humanities and Social Sciences (4 Projects)

○ Humanities(2 Projects)

Principal Investigator		Title	Term of project	Total (Thousand yen)
Hitoshi Kobayashi	The Association for the Advancement of Fine Arts, Osaka/Curatorial Department/Curator	Synthetic Studies on Tomb Figurines in the Sui and Tang Dynasties	FY2007-2011	3,700
Akira Takada	Kyoto University/Graduate School of Asian and African Area Studies/Assistant Professor	Cultural formation of responsibility in caregiver-child interactions	FY2007-2011	50,400

○ Social sciences(2 Projects)

Principal Investigator		Title	Term of project	Total (Thousand yen)
Kaoru Iokibe	The University of Tokyo/Institute of Social Science/Associate Professor	Treaty Revision in the State Building Process of Meiji Japan	FY2007-2011	9,400
Kenichiro Tsutsui	Tohoku University/Graduate School of Life Sciences/Associate Professor	Neural mechanisms of category formation and categorical reasoning	FY2007-2011	87,700

Science and Engineering （12 Projects）

○ Mathematical and physical sciences（3 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Kensuke Kobayashi	Kyoto University/Institute for Chemical Research/Associate Professor	Generation and Detection of Quantum Correlation in Semiconductor Nanostructures	FY2007–2011	84,900
Yoichi Ando	Osaka University/Institute of Scientific and Industrial Research/Professor	Mott Insulator and Spin Hall Insulator: Elucidating the Physics of Nontrivial Insulators	FY2007–2011	96,300
Kei Hirose	Tokyo Institute of Technology/Graduate School of Science and Engineering/Professor	High-Pressure Earth Science: Materials Properties in the Lowermost Mantle and Core	FY2007–2011	88,100

○ Chemistry（4 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Shigehiro Yamaguchi	Nagoya University/Graduate School of Science/Professor	New pi-Electron Materials with Extremely Superior Photophysical and Electronic Properties	FY2007–2011	87,900
Yoshiaki Nishibayashi	The University of Tokyo/Graduate School of Engineering/Associate Professor	Development of Innovative Transformations by Using Synergistic Effect of Plural Metals	FY2007–2011	61,500
Masami Kamigaito	Nagoya University/Graduate School of Engineering/Professor	Precision Synthesis of Multiple Controlled Polymers via Radical Polymerization	FY2007–2011	88,600
Shiyoshi Yokoyama	Kyushu University/Institute for Materials Chemistry and Engineering/Professor	Polymer photonic crystal for active optical device applications	FY2007–2011	88,100

○ Engineering（5 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Heiji Watanabe	Osaka University/Graduate School of Engineering/Professor	Fabrication of High-quality SiC-MOSFETs for Advanced Power Electronics	FY2007–2011	68,700
Toshiyuki Tsuchiya	Kyoto University/Graduate School of Engineering/Associate Professor	Explanation of reaction layer fatigue in silicon microstructure for development of highly-reliable MEMS devices.	FY2007–2011	86,300
Yasutaka Fujimoto	Yokohama National University/Graduate School of Engineering/Associate Professor	A High-power and Flexible Humanoid Robot Driven by Artificial Muscles of Back-drivable Spiral Motors	FY2007–2011	89,600
Yoshikazu Takahashi	Kyoto University/Disaster Prevention Research Institute/Associate Professor	Improvement of Disaster Mitigation Technology by Functional Cooperation of Existing Seismic Test Facilities	FY2007–2011	88,900
Yutaka Yoshida	Nagoya University/Graduate School of Engineering/Associate Professor	Creation of hybrid energy materials with highly ordered nano-structure	FY2007–2011	79,200

Biological Sciences （12 Projects）

○ Biology（2 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Shinichiro Sawa	The University of Tokyo/Graduate school of Science/Associate Professor	An analysis of CLE peptides as an morphoges in plant morphogenssis	FY2007–2011	88,300
Kazushige Touhara	The University of Tokyo/Graduate school of Frontier Sciences/Associate Professor	Molecular mechanisms for recognition and signal transduction of sex-specific peptides in the mouse vomeronasal organ	FY2007–2011	88,700

○ Agricultural sciences （2 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Ken Shirasu	RIKEN/Plant Immunity Research Team/Team Leader	Molecular mechanisms of plant immunity and its suppression by pathogens	FY2007–2011	88,100
Takashi Yoshimura	Nagoya University/Graduate School of Bioagricultural Sciences/Associate Professor	Mechanisms underlying the deep brain photoreception and seasonal time measurement in vertebrates	FY2007–2011	88,600

○ Medicine, dentistry, and pharmacy（8 Projects）

Principal Investigator		Title	Term of project	Total (Thousand yen)
Taisuke Tomita	The University of Tokyo/Graduate School of Pharmaceutical Sciences/Associate Professor	Discovery for mechanism-based drugs for Alzheimer's disease by chemical biology	FY2007–2011	88,600
Kunihiko Nishino	Osaka University/Institute of Scientific and Industrial Research/Assistant Professor	Roles of orphan transporters in multidrug-resistant bacteria and development of therapeutic strategies to control infectious diseases	FY2007–2011	49,600
Kiyoshi Takeda	Osaka University/Graduate School of Medicine/Professor	Mechanism for regulation of innate immune responses	FY2007–2011	88,600
Mineo Kurokawa	The University of Tokyo/University Hospital/Professor	Elucidation of molecular pathogenesis and therapeutic targets for refractory hematological malignancies	FY2007–2011	77,300
Yoko Aoki	Tohoku University/Graduate School of Medicine/Assistant Professor	Novel functions of proto-oncogenes in human development	FY2007–2011	81,200
Emi Nishimura	Kanazawa University/Cancer Research Institute/Professor	Elucidation of the mechanisms of hair graying: an approach for tissue ageing	FY2007–2011	88,600
Toshihide Yamashita	Chiba University/Graduate School of Medicine/Professor	Molecular mechanism of regeneration and plasticity of the injured central nervous system	FY2007–2011	88,400
Masaru Inatani	Kumamoto University/University Hospital/Lecturer	Elucidation of the role of heparan sulfate in neural crest cell differentiation and establishment of a new concept of glaucoma pathogenesis	FY2007–2011	88,100

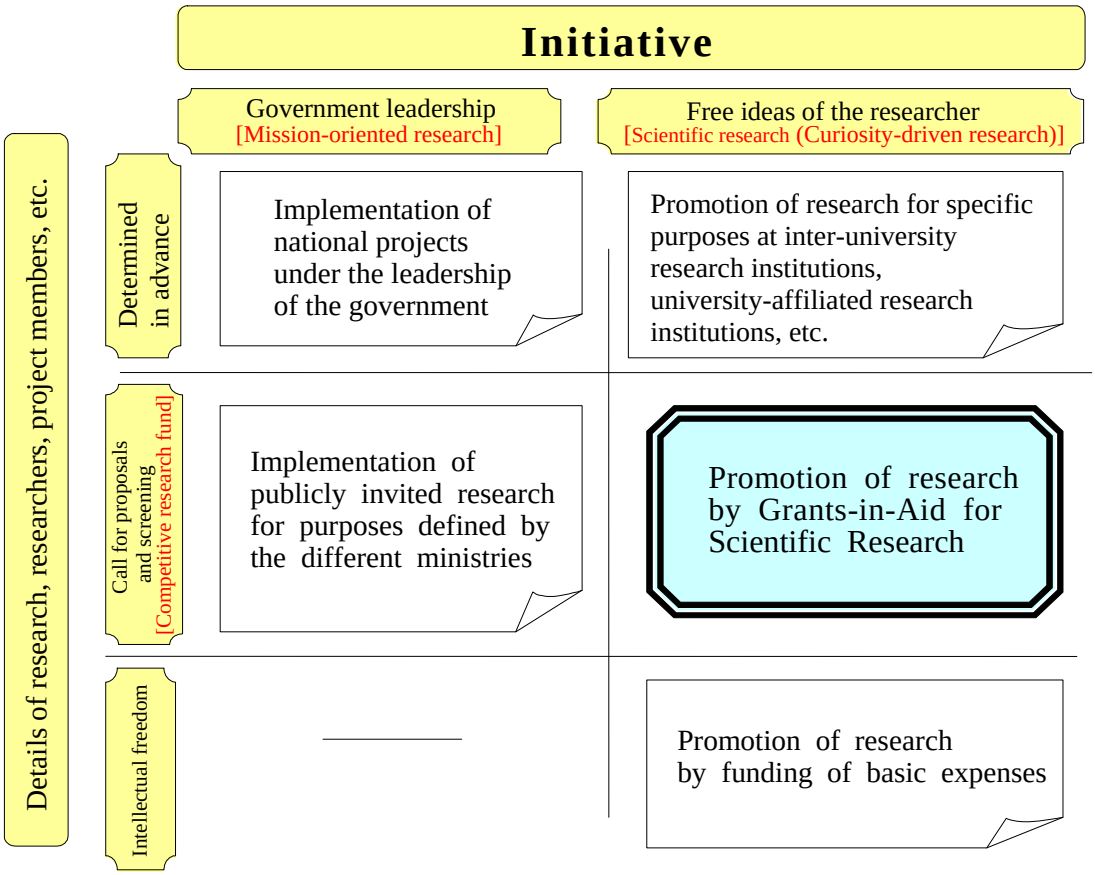
Reference

Grants-in-Aid for Scientific Research(KAKENHI)

1. Purpose and Character of Grants-in-Aid for Scientific Research

Grants-in-Aid for Scientific Research are competitive funds that are intended to significantly develop all scientific research (research based on the free ideas of the researcher), from basic to applied research in all fields, ranging from the humanities and the social sciences to the natural sciences. The grants provide financial support for creative and pioneering research projects that will become the foundation of social development. The research projects are selected using a peer-review screening process (screening by multiple researchers whose field of specialization is close to that of the applicant).

Classification of the promotion of research and the positioning of the Grants-in-Aid for Scientific Research by the Government



❖ Grants-in-Aid for Scientific Research (193.2 billion yen) account for about 5% of the entire budget for publicly funded science and technology (approximately 3.6 trillion yen), and about 40% of the entire budget for competitive funding (approximately 481.3 billion yen).

2. Research Categories

For the following research categories, research institutions manage and carry out the different procedures on behalf of researchers.

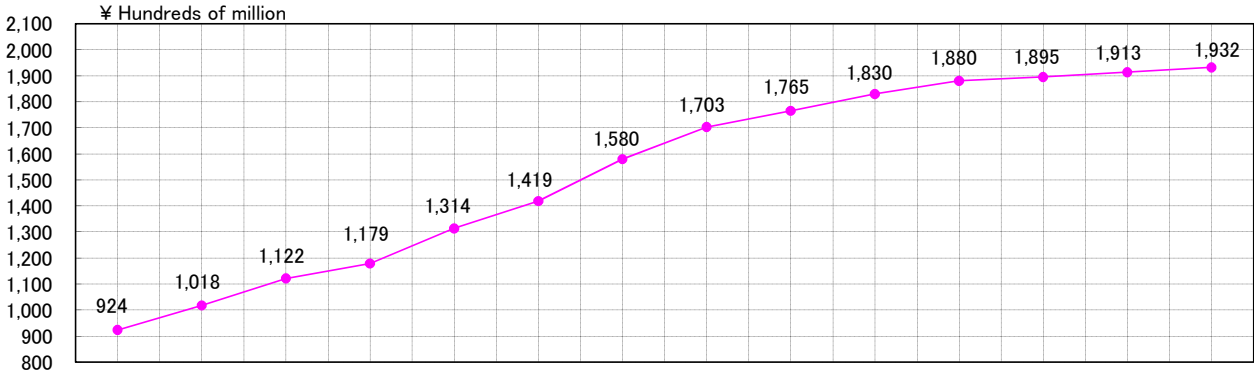
Research categories, etc.	Purposes and description of the research category
Grants-in-Aid for Scientific Research	
Specially Promoted Research ※	Highly regarded research in the international arena that is likely to yield highly acclaimed research achievements (There is no limit to the period or budget although, as a guide, a period of three to five years and a budget of around 500 million yen per project may be awarded.)
Scientific Research on Priority Areas	Research fields that will lead to the upgrading and enhancement of scientific research in Japan; research fields that require effort on a global scale; and/or research fields that have particularly strong social demand will be specified. The objective is to flexibly and effectively plan the promotion of research. (The period is three to six year. In principle, the budget is set at around 20 million to 600 million yen per fiscal year per field.)
Scientific Research on Innovative Areas	(Research in a proposed research area) New research areas that will lead to the upgrading and enhancement of scientific research in Japan. The new research areas are proposed by one researcher or by a group of researchers, and will develop through the effort to cultivate collective research, research personnel, etc. (The period is five years. In principle, the budget is set at around 10 million to 300 million yen per fiscal year per field.) (Research under a proposed research project) Innovative and challenging research that is very likely to lead to a breakthrough in academic research by the development of the research project in question. The funding is not restricted to research projects that are expected to yield certain and tangible research achievements. (The period is three years. The budget is 10 million yen per fiscal year.)
Scientific Research※	(S) Creative/pioneering research done by one researcher or a relatively small group of researchers (The period is five years. The budget ranges from 50 million yen to around 200 million yen per project.) (A)(B)(C) Creative/pioneering research done by one researcher or jointly by multiple researchers (The period is three to five years.) (Classified in A, B or C, depending on the total budget provided) (A) From 20 million to 50 million yen (B) From 5 million yen to 20 million yen (C) 5 million yen or less
Exploratory Research ※	Uniquely original research in an early stage of development (The period is one to three years. The budget is 5 million yen or less per project)
Grant-in-Aid for Young Scientists ※	(S) Research done by one researcher aged 42 or less (The period is five years. The budget ranges roughly from 30 million yen to 100 million yen per project.) (A)(B) Research done by one researcher aged 37 or less (The period is two to four years. Classified in A or B, depending on the total budget provided.) (A) from 5 million yen to 30 million yen (B) 5 million yen or less (Start-up) Research done by one researcher who has just started employment at a research institution (The period is two years. The budget is 1.5 million yen or less per year.)
Encouragement of Scientists※	Research carried out by an employee of an employee of an educational or research institution or a corporation or any other individual (The period is one year. The budget is 1 million yen.)

Grant-in-Aid for Special Purposes		Urgent and critical research subjects. Experimental trials concerning research aid
Grant-in-Aid for Publication of Scientific Research Results		
	Publication of Scientific Research Results	Support for publishing the results of highly significant research conducted by researcher groups and for disseminating such information internationally
	Scientific Literature ※	Funding of Scientific Literature issued by an individual or a group of researchers to disclose scientific research achievements
	Databases※	Funding of databases created by an individual or a group of researchers for public availability
Grant-in-Aid for JSPS Fellows※		Funding of research done by JSPS Fellows, including Foreign JSPS Fellows (for a period of up to three years)
Grant-in-Aid for Creative Scientific Research※		Among research supported by Grants-in-Aid for Scientific Research and others, focus is placed on the most outstanding research field. Research projects that are especially important in promoting the research field in question are selected to promote highly creative scientific research (recommendation required; for a period of five years)

※Screening are handled by JSPS

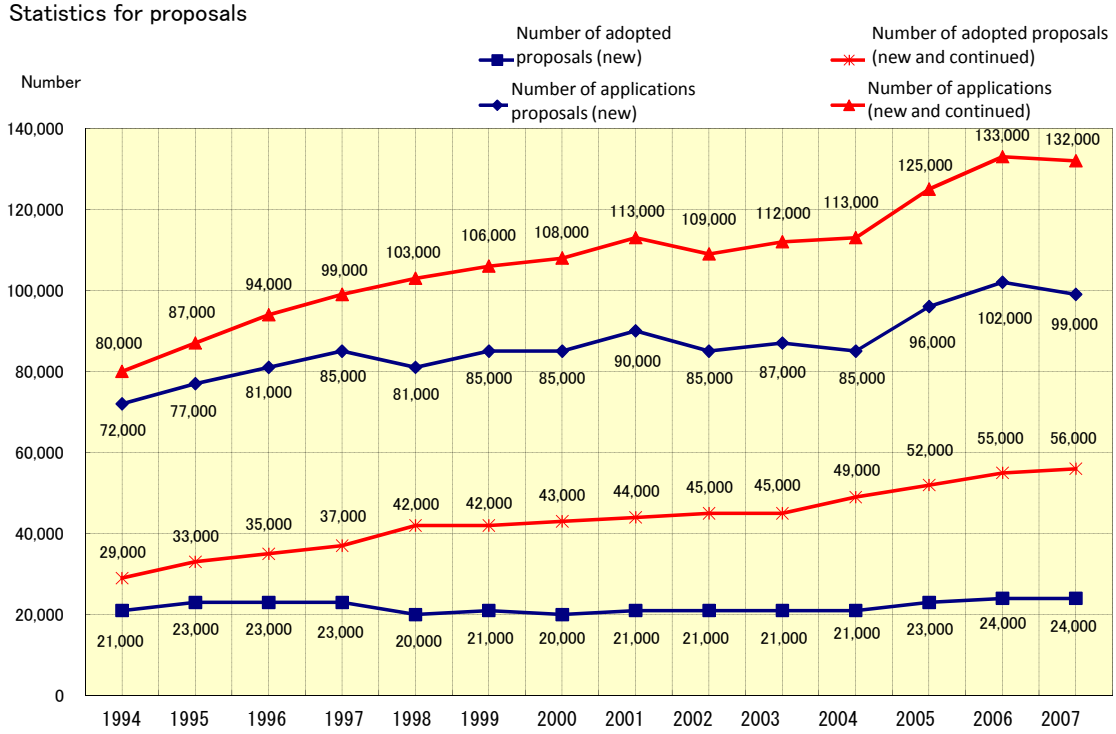
3. Budget Transition and Others

○ Budget transition



FY	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Budget (¥ hundreds of millions)	924	1,018	1,122	1,179	1,314	1,419	1,580	1,703	1,765	1,830	1,880	1,895	1,913	1,932
Year-on-year increase (%))	12.1	10.2	10.2	5.1	11.5	8.0	11.3	7.8	3.6	3.7	2.7	0.8	0.9	1.0

○ Statistics for proposals



○ ratio of adopted proposals and vacancy filled

FY	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Adopted rate (%)	29.4	28.3	27.1	24.8	24.3	23.9	23.1	24.6	23.7	24.8	24.0	23.5	24.3
Rate of filled vacancy (%)	74.9	74.6	72.3	71.5	74.7	77.2	78.2	76.1	76.2	76.5	76.4	77.5	75.7

Note: The table shows data on initially allocation in each fiscal year.

4. Actual Subsidization of Grants-in-Aid for Scientific Research for FY2008

(1) New

As of September 2008

Research category	Number of applications			Total grant disbursements	Per-project grants	
	Received	Adopted	Ratio		Average	Largest
	#	#	%	thousans of yen	thousans of yen	thousans of yen
Grants-in-aid for scientific research	〔 94,923 〕 97,052	〔 20,850 〕 19,958	〔 22.0 〕 20.6	〔 62,182,300 〕 57,381,095 【 15,028,539 】	〔 2,982 〕 2,875	〔 163,700 〕 261,400
Grant-in-aid for specially promoted research	〔 139 〕 114	〔 20 〕 19	〔 14.4 〕 16.7	〔 2,072,900 〕 1,907,800 【 572,340 】	〔 103,645 〕 100,411	〔 163,700 〕 261,400
Grant-in-aid for researchin priority areas	〔 5,890 〕 5,999	〔 1,210 〕 1,481	〔 20.5 〕 24.7	〔 6,086,500 〕 4,953,000	〔 5,030 〕 3,344	〔 72,400 〕 42,000
Grant-in-aid for scientific research（S）	〔 431 〕 551	〔 81 〕 94	〔 18.8 〕 17.1	〔 2,025,300 〕 3,683,500 【 1,105,050 】	〔 25,004 〕 39,186	〔 54,400 〕 96,800
Grant-in-aid for scientific research（A）	〔 2,345 〕 2,439	〔 543 〕 545	〔 23.2 〕 22.3	〔 7,437,200 〕 7,307,000 【 2,192,100 】	〔 13,697 〕 13,407	〔 31,400 〕 31,400
Grant-in-aid for scientific research（B）	〔 11,345 〕 11,717	〔 2,649 〕 2,601	〔 23.3 〕 22.2	〔 16,592,200 〕 14,924,200 【 4,477,260 】	〔 6,264 〕 5,738	〔 14,200 〕 14,500
Grant-in-aid for scientific research（C）	〔 32,645 〕 32,939	〔 7,500 〕 7,128	〔 23.0 〕 21.6	〔 12,572,800 〕 10,570,900 【 3,171,270 】	〔 1,676 〕 1,483	〔 3,500 〕 3,600
Grant-in-aid for exploratory research	〔 15,000 〕 15,605	〔 1,820 〕 1,117	〔 12.1 〕 7.2	〔 3,319,000 〕 1,983,000	〔 1,824 〕 1,775	〔 3,700 〕 3,700
Grant-in-aid for encouragement of young scientists（S）	〔 1,262 〕 805	〔 35 〕 39	〔 2.8 〕 4.8	〔 600,000 〕 812,100 【 243,630 】	〔 17,143 〕 20,823	〔 49,200 〕 55,800
Grant-in-aid for encouragement of young scientists（A）	〔 1,415 〕 1,430	〔 244 〕 254	〔 17.2 〕 17.8	〔 2,037,600 〕 1,993,300 【 597,990 】	〔 8,351 〕 7,848	〔 17,700 〕 16,900
Grant-in-aid for encouragement of young scientists（B）	〔 17,842 〕 18,322	〔 5,132 〕 5,068	〔 28.8 〕 27.7	〔 7,925,700 〕 7,751,800 【 2,325,540 】	〔 1,544 〕 1,530	〔 3,200 〕 3,500
Grant-in-aid for encouragement of young scientists（Start-up）	〔 3,459 〕 3,749	〔 834 〕 934	〔 24.1 〕 24.9	〔 1,013,100 〕 1,144,530 【 343,359 】	〔 1,215 〕 1,225	〔 1,400 〕 1,500
Grant-in-aid for encouragement of scientists	〔 3,150 〕 3,382	〔 782 〕 678	〔 24.8 〕 20.0	〔 500,000 〕 349,965	〔 639 〕 516	〔 1,000 〕 900
Grant-in-Aid for special purposes (a trial of pluriannual application)	〔 245 〕 230	〔 68 〕 69	〔 27.8 〕 30.0	〔 110,000 〕 90,000	〔 1,618 〕 1,304	〔 3,000 〕 2,600
Grant-in-aid for publication of scientific research results	〔 1,599 〕 1,330	〔 483 〕 455	〔 30.2 〕 34.2	〔 1,604,340 〕 1,277,100	〔 3,322 〕 2,807	〔 35,800 〕 43,100
Grant-in-aid for JSPS fellows	〔 2,541 〕 2,553	〔 2,541 〕 2,553	〔 100.0 〕 100.0	〔 2,412,700 〕 1,593,653	〔 950 〕 624	〔 3,000 〕 3,000
Grant-in-aid for creative scientific research *	〔 85 〕 –	〔 18 〕 –	〔 21.2 〕 –	〔 1,526,400 〕 – 【 – 】	〔 84,800 〕 –	〔 103,800 〕 –
Total	〔 99,393 〕 101,165	〔 23,960 〕 23,035	〔 24.1 〕 22.8	〔 67,835,740 〕 60,341,848 【 15,028,539 】	〔 2,831 〕 2,620	〔 163,700 〕 261,400

Notes:
1. The figures in 〔 〕indicate the previous fiscal year.
2. The figures in【 】indicate indirect funding (excluded from the total).
3. The category with an asterisk (*) has been discontinued to call the new proposals.

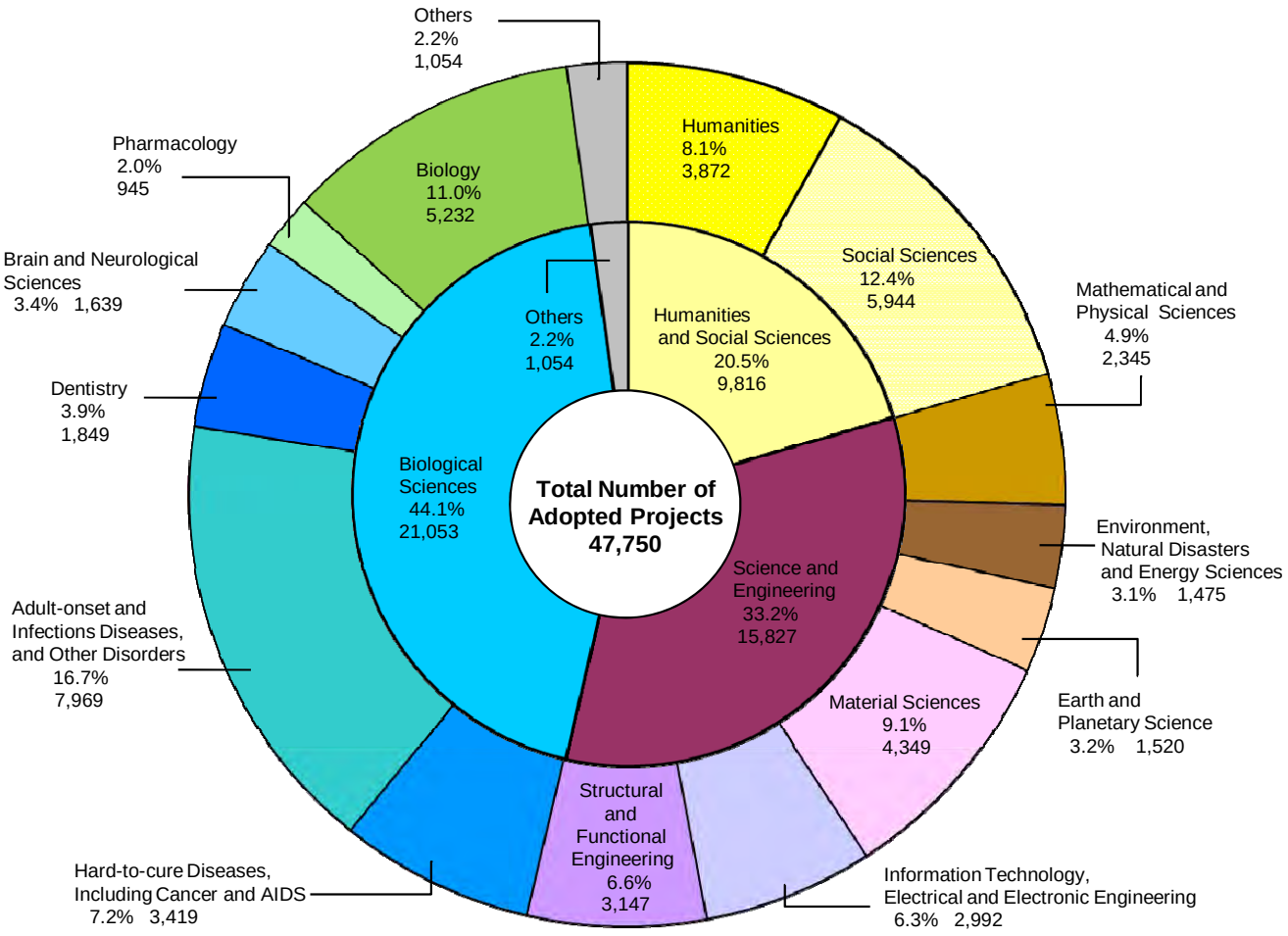
(2) New and Ongoing

As of September 2008

Research category	Number of applications			Total grant disbursements	Per-project grants	
	Received	Adopted	Ratio		Average	Largest
	#	#	%	thousands of yen	thousands of yen	thousands of yen
Grants-in-aid for scientific research	〔 123,960 〕 126,594	〔 49,806 〕 49,435	〔 40.2 〕 39.1	〔 145,547,033 〕 140,276,144 【 32,147,767 】	〔 2,922 〕 2,838	〔 310,400 〕 306,100
Grant-in-aid for specially promoted research	〔 204 〕 181	〔 85 〕 86	〔 41.7 〕 47.5	〔 6,595,000 〕 7,051,900 【 2,115,570 】	〔 77,588 〕 81,999	〔 310,400 〕 306,100
Grant-in-aid for research in priority areas	〔 8,575 〕 7,995	〔 3,895 〕 3,477	〔 45.4 〕 43.5	〔 32,142,100 〕 28,559,000	〔 8,252 〕 8,214	〔 177,500 〕 281,100
Grant-in-aid for scientific research (S)	〔 698 〕 832	〔 344 〕 372	〔 49.3 〕 44.7	〔 5,813,700 〕 7,705,500 【 2,311,650 】	〔 16,900 〕 20,714	〔 54,400 〕 96,800
Grant-in-aid for scientific research (A)	〔 3,552 〕 3,672	〔 1,731 〕 1,767	〔 48.7 〕 48.1	〔 16,782,300 〕 17,206,700 【 5,162,010 】	〔 9,695 〕 9,738	〔 31,400 〕 34,300
Grant-in-aid for scientific research (B)	〔 16,330 〕 16,709	〔 7,598 〕 7,559	〔 46.5 〕 45.2	〔 34,011,000 〕 32,224,700 【 9,667,410 】	〔 4,476 〕 4,263	〔 14,200 〕 14,500
Grant-in-aid for scientific research (C)	〔 42,363 〕 43,896	〔 17,196 〕 18,068	〔 40.6 〕 41.2	〔 22,094,487 〕 21,301,619 【 6,390,486 】	〔 1,285 〕 1,179	〔 3,500 〕 3,600
Grant-in-aid for exploratory research	〔 17,059 〕 17,684	〔 3,879 〕 3,196	〔 22.7 〕 18.1	〔 5,506,065 〕 4,207,955	〔 1,419 〕 1,317	〔 3,700 〕 3,700
Grant-in-aid for encouragement of young scientists (S) *1	〔 1,262 〕 840	〔 35 〕 74	〔 2.8 〕 8.8	〔 600,000 〕 1,412,100 【 423,630 】	〔 17,143 〕 19,082	〔 49,200 〕 55,800
Grant-in-aid for encouragement of young scientists (A)	〔 2,000 〕 1,928	〔 829 〕 752	〔 41.5 〕 39.0	〔 4,830,700 〕 4,087,632 【 1,226,289 】	〔 5,827 〕 5,436	〔 19,300 〕 16,900
Grant-in-aid for encouragement of young scientists (B)	〔 24,518 〕 24,899	〔 11,808 〕 11,645	〔 48.2 〕 46.8	〔 14,716,171 〕 14,050,603 【 4,215,181 】	〔 1,246 〕 1,207	〔 3,200 〕 3,500
Grant-in-aid for encouragement of young scientists (Start-up)	〔 4,249 〕 4,576	〔 1,624 〕 1,761	〔 38.2 〕 38.5	〔 1,955,510 〕 2,118,470 【 635,541 】	〔 1,204 〕 1,203	〔 1,500 〕 1,500
Grant-in-aid for encouragement of scientists	〔 3,150 〕 3,382	〔 782 〕 678	〔 24.8 〕 20.0	〔 500,000 〕 349,965	〔 639 〕 516	〔 1,000 〕 990
Grant-in-aid for special purposes (a trial of pluriannual application)	〔 245 〕 230	〔 68 〕 69	〔 27.8 〕 30.0	〔 110,000 〕 90,000	〔 1,618 〕 1,304	〔 3,000 〕 2,600
Grant-in-aid for publication of scientific research	〔 1,631 〕 1,350	〔 515 〕 475	〔 31.6 〕 35.2	〔 1,800,000 〕 1,367,900	〔 3,495 〕 2,880	〔 35,800 〕 43,100
Grant-in-aid for JSPS fellows	〔 5,636 〕 5,911	〔 5,636 〕 5,911	〔 100.0 〕 100.0	〔 5,315,818 〕 4,710,395	〔 943 〕 797	〔 3,000 〕 3,000
Grant-in-aid for creative scientific research *2	〔 164 〕 79	〔 97 〕 79	〔 59.1 〕 100.0	〔 7,319,100 〕 5,766,200 【 1,729,860 】	〔 75,455 〕 72,990	〔 116,500 〕 109,300
Total	〔 131,636 〕 134,164	〔 56,122 〕 55,969	〔 42.6 〕 41.7	〔 160,091,951 〕 152,210,639 【 33,877,627 】	〔 2,853 〕 2,720	〔 310,400 〕 306,100

Notes:
1. The figures in 〔 〕 indicate the previous fiscal year.
2. The figures in 【 】 indicate indirect funding (excluded from the total).
3. For the category with *1, only new proposals in FY2007 have been recorded
4. For the category with *2, only continued proposals in FY2008 have been recorded

5. Chart for the Budget by Research Field（FY2008）



※ This chart is a classification of initially adopted 47,750 proposals of Specially Promoted Research, Scientific Research on Priority Areas, Scientific Research, Exploratory Research, Grant-in-Aid for Young Scientists and Grant-in-Aid for Creative Scientific Research of KAKENHI in FY2008（new and continued）.
（Excluding new proposals of Grant-in-Aid for Specially Promoted Research, Grant-in-Aid for Scientific Research (S), Grant-in-Aid for Young Scientists and Start up）

Inquiries:

Research Aid Division II, Research Program Department,
Japan Society for the Promotion of Science
8 Ichibancho, Chiyoda-ku, Tokyo 102-8472
Tel: +81-3-3263-4254 (in charge of Specially Promoted Research)
Tel: +81-3-3263-4388,4632 (in charge of Scientific Research (S))
Tel: +81-3-3263-1431,4617 (in charge of Grant-in-Aid for Young Scientists (S))
URL: http://www.jsps.go.jp/english/e-grants/grants.html